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June **NATURAL HISTORY** 1943

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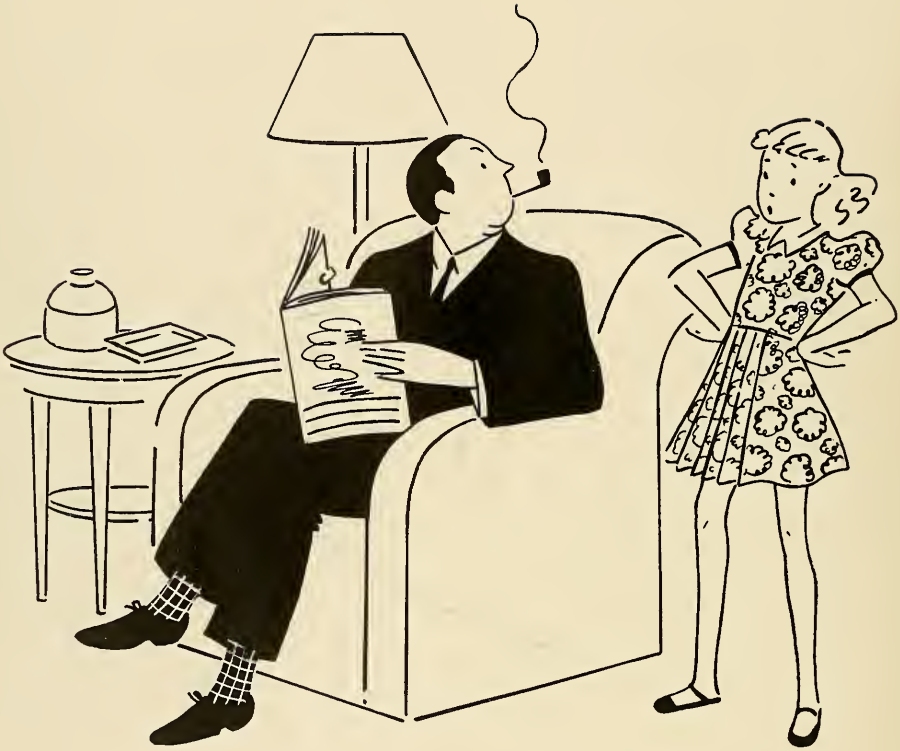
VOLUME LII. No. 1

FIFTY CEN



"Sorry, Sis. Mr. Smithers is next on the list."

"Gosh, Daddy. If you'd tell our friends how to subscribe, then NATURAL HISTORY could stay at home!"

Geography Begins at Home

In the awareness of a new and greater role in world affairs our nation is turning with renewed interest to the study of geography. The various branches of this broad subject are leaping to spectacular prominence in the curriculums of all institutions of higher learning. The demands of our armed forces are great and insistent. It is urged that a G for geography be added to the three R's of elementary education.

This awakening of a great people to a full sense of their responsibilities to themselves and to the world is a splendid fruit growing from the world-decay which gave soil for its seed and nourishment for its roots. All educational institutions may join wholeheartedly in the effort to satisfy a newborn craving for knowledge in a heretofore much neglected subject. The natural history museums obviously have a great contribution to make to this effort.

Having set as our goal a better and more mutual understanding of the world and ourselves, we must also find the trail which will lead us most quickly to our destination. This trail was marked out for us long ago by a signpost which reads: "Understand yourself that you may learn to understand others."

There is a dual significance in this ancient bit of wisdom. It does not only tell us that we can never hope to attain any real understanding of the problems and actions of other individuals or other nations until we learn to translate them into the terms of our own national experience. It should also remind us that our counsel will find scant appreciation abroad, beyond thankfulness for any gifts which may go with it, so long as we remain unconscious or ignorant of our own problems at home and therefore unable to throw them into the discussion for an equal exchange of advice. No one will listen very long to the counsel of one who does not know his own affairs and is unwilling to have them discussed while advising others.

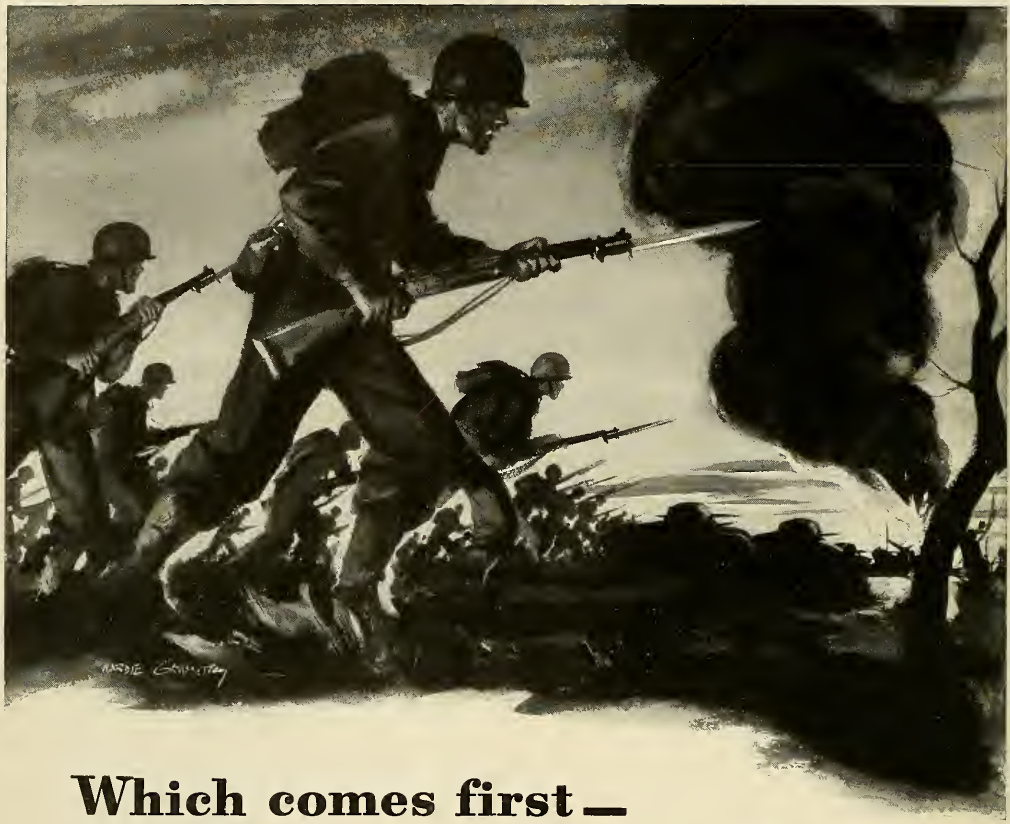
In our general educational neglect of geography the neglect of American geography has been even greater and more startling than our lack of concern with the geographical problems of the rest of the world. There is undoubtedly no other nation on a similar level of education which has required of its pupils and its citizens so little knowledge of the natural and cultural geography of their own country. As a result, our well-meant interest in the problems of other peoples tends to find expression in a disembodied voice speaking from the emptiness of space, without mundane problems of its own. We are innocently unconscious of our own national problems and experiences because we have not been educated to know them. We are unable to establish a common ground for discussion with members of other nations because we do not know the ground on which we stand ourselves. We can only advise and advise *ad nauseam*.

It is therefore not only in the national self-interest, but also in the interest of what we may be able to contribute to the entire world, that it is so supremely important for us to remember that geography begins at home.

When we, also, have finally learned enough about our own country for each of us to be able to comment upon the problems of other nations by reference to our own problems in Maine or Mississippi, New York or Oregon,—then, and then only, will the tone of officiousness disappear from our voices and our counsel will at long last be welcome for its own worth in the forums of the world.

A. E. Parr

Director, the American Museum of Natural History



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LETTERS

Sirs:

I wish to express our vast appreciation for your splendid magazine, which we always read from cover to cover, almost on the day of its arrival.

The April number contains an article of special interest—"The Creation of an Indian Jar"—showing the pottery making of the San Ildefonso Indians.

Congressman Clinton P. Anderson of New Mexico has introduced a bill (H. R. 323) which has been approved and which if carried further will spell disaster for hopes and homes of many Indians in New Mexico. I will quote a letter just received by a friend of mine from Adam Martinez of San Ildefonso Pueblo:

"We have just heard or learned of the construction of a dam on the Rio Grande which means that our village and farm lands would be destroyed. This would not only mean a loss to us Indians but to the cultural life of New Mexico and our whole nation. We Indians are again on the war path with the rest of our country, fighting and giving our lives for this country of freedom and rights for every man. We feel we have a right to our ancestral lands and our way of living upon them, so long as we do no harm to the other people. So we are asking our friends to help us, as we are much worried and don't know what to do."

The Indians need our assistance. . . . I am writing to you because I think that you and your friends and associates may be able to do something about it.

(Mrs.) Edna Badgley Piper.
Long Beach, Calif.

* * *

Sirs:

Would it not be possible for you to point out the danger that threatens the ancient Pueblos of the Southwest by the introduction by Representative Anderson of a bill (H. R. 323) proposing to dam the White Rock Canyon in New Mexico. The project, if passed, will destroy the farm lands and even the homes and shrines of San Ildefonso and Santa Clara and partially flood the lands of Santo Domingo and Cochiti.

Such action by our legislators would be all too consistent with the reprehensible Indian policy of the past which many of us had hoped was done with forever. The supposed advantages of such a project are questionable and are clearly overweighed by the harm which would ensue. Moreover, the moral issue is significant. The Pueblo Indians are a sedentary folk who have cultivated their lands for centuries. Their lives in every detail are bound up inextricably with the land they occupy. The antiquity of their claim was recognized by our government in the treaty of Guadalupe. To drive them from their ancient fields now would be a distinct betrayal of trust and a procedure at variance with the principles for which we hope our country stands.

The loss of faith in our professions of justice, the destruction of the most ancient living communities in the United States, and the loss of architectural treasures seem a high price to pay for the slight material benefits which the proposed dam would contribute to the local white population.

H. L. Shapiro,
Department of Anthropology.
The American Museum of
Natural History,
New York, N. Y.

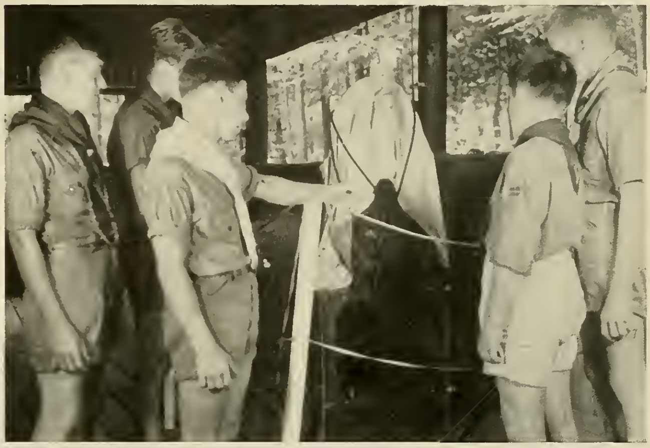
* * *

Sirs:

No one seems to have commented on the cover for March, so I should like to say the beautiful picture does show an acacia, but not *Acacia arabica*. That species has thorny stems, and the flower clusters, large for an acacia, are borne singly or in pairs along the stems, not in racemes. The species illustrated is apparently either *A. Baileyana,* the one most widely grown for its flowers in California, or *A. decurrens,* also widely grown here. Both these are Australian. . . . As far as beauty is concerned, the one used on the cover much surpasses *A. arabica.*

George T. Hastings.
Santa Monica, Calif.

George T. Hastings, formerly Editor of *Torreya,* is correct. The tree is apparently *A. Baileyana,* as the botanist who originally identified the picture now readily agrees.—Ed.

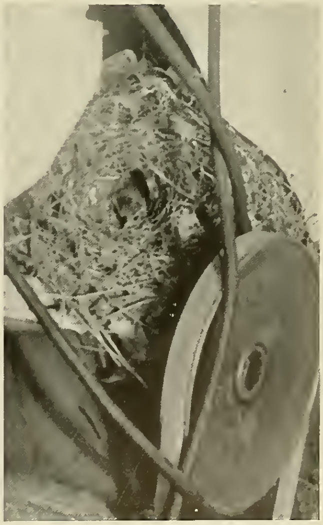


Sirs:

Last summer at our Piedmont Boy Scout Camp at Lake Lanier, near Tryon, N. C., a pair of Carolina wrens *(Thryothorus ludovicianus ludovicianus)* moved into our woodworking shop. With motor driven band saws and other craft machinery in operation and with Scouts by the score hammering and working, these wrens insisted on building right in the middle of a band saw as soon as it was stopped. At first the nesting materials were removed, but the wrens would not be discouraged. So the machine was covered over and roped off, and with the other saws and machines in almost constant operation, the wrens completed the nest and raised their brood.

It is needless for me to say that our Boy Scouts find a great interest in your publication.

R. M. Schiele,
Gastonia, N. C. *Scout Executive.*



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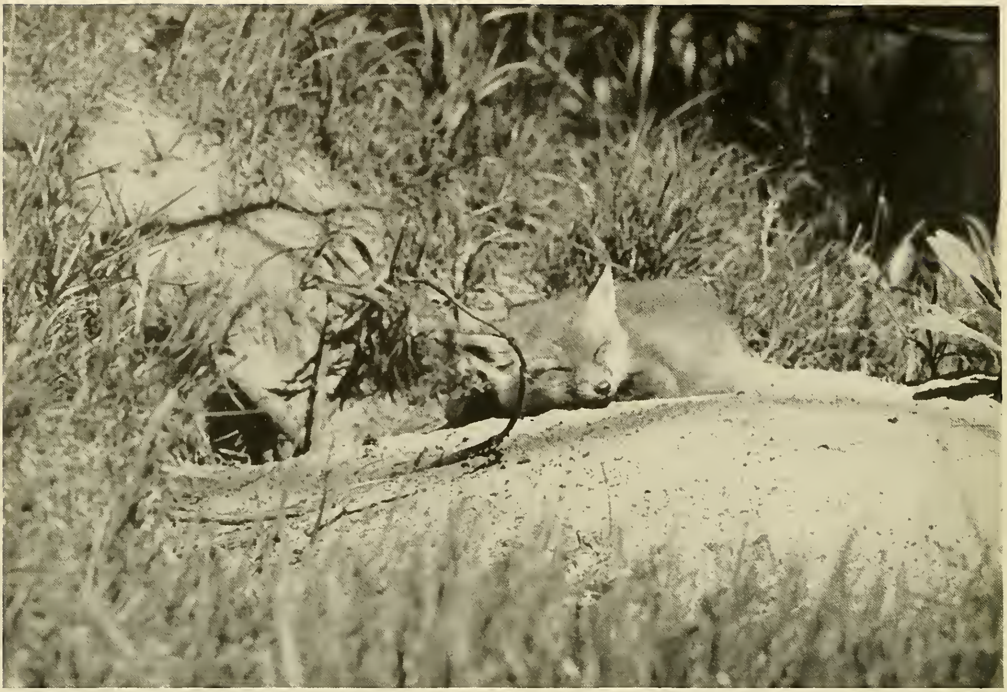


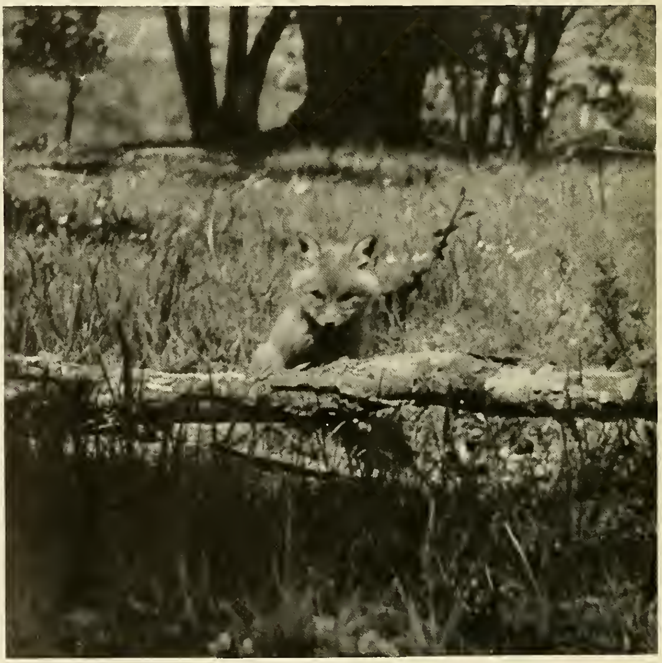
Sirs:

When I was told that there were foxes in the vicinity I crept up Indian fashion and secured this photograph. It shows a baby red fox sleeping and sunning itself at the entrance to its den. This was in late spring.

The other photograph was taken by a friend of mine, Walter Haskell, who says he whistled when he saw the fox, whereupon the little fellow sat up and looked as you see him here.

Myrton S. Reed.

Worcester, Mass.



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The Museum and Inter-American Relations

THE invitation to accept a distinguished honor on behalf of the Chilean Government has been extended to Mr. Michael Lerner for his services to Chile in connection with his Expedition of 1940 under the auspices of the American Museum of Natural History. This Expedition for the purpose of studying marine fishes achieved important results not only in the scientific sense but in the cultural relations of the two countries. The award is the decoration "Al Mérito" in the degree of "Comendador."

Toward the success of Mr. Lerner's Expedition the Chilean Government and press, as well as local officials and officers of prominent industries, banks, and transportation lines, vied with one another in hospitality and assistance. In bestowing this honor on Mr. Lerner, the Chilean Government has chosen an impressive way to show the feeling of mutual interest that lies between the two nations.

The happy relations that originated in this scientific objective have been maintained and furthered through the co-operation of the Chilean representatives of the International Game Fish Association—an organization whose headquarters are in the American Museum.

Señor Anibal Jara, Consul General of Chile, stated at the Museum on May 14 that it was highly gratifying to him, in inviting Mr. Lerner to the ceremony of bestowal, to be the interpreter of the devotion and services of Mr. and Mrs. Lerner to his country, and to transmit this evidence of the esteem of the President of the Republic, Señor Rios, and of the Minister of Foreign Affairs, Señor Fernandez.

The bestowal will probably be made in Washington early in June, when the President of Chile will be in this country.

A.M.N.H. Photo

Mr. Michael Lerner (*left*) and Señor Anibal Jara, Consul General of Chile, on the occasion of the announcement at the American Museum that the former would be the recipient of a distinguished honor from the Chilean Government early in June

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President — Albert E. Parr, Director

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Beaver Engineers........John Eric Hill 41
Beavers accomplish difficult engineering feats and leave a fertile meadow behind

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Pan-Pacific Photo

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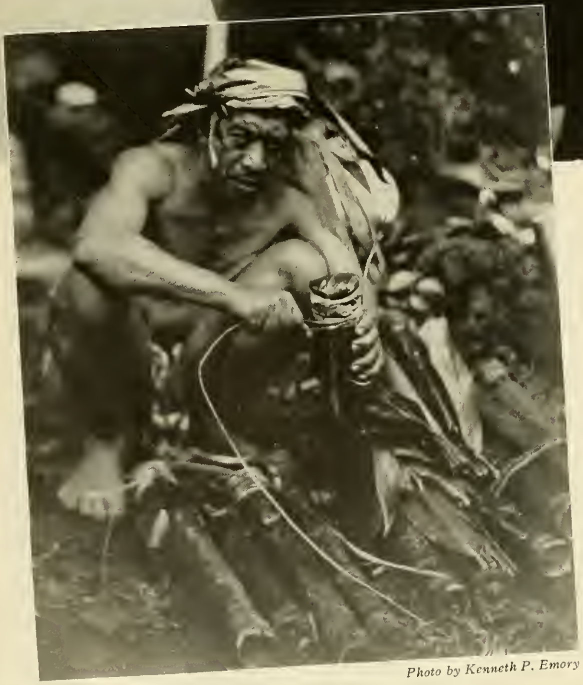

Photo by Kenneth P. Emory

◀ A NATIVE of Tahiti "canning" wild pig meat. Pieces of meat are put into a joint of bamboo, and the opening is then sealed by a ti-leaf as shown at left. To preserve the meat, the joint is recooked each day in the ground oven

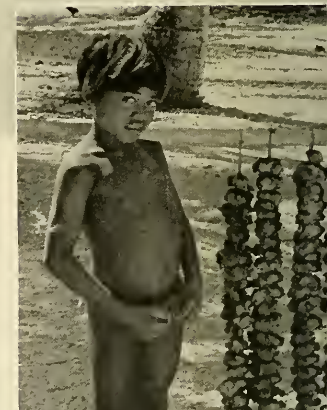

Photo by Kenneth P. Emory

➤ STRINGS of dried Tridacna clams: a provision against stormy days

Every Man His Own *Robinson Crusoe*

By
KENNETH P. EMORY

A novel program to teach our South Sea fighters how to fare for themselves in time of need by use of ingenious native methods

A COURSE in South Sea Island adaptation, the curriculum determined by the Bernice P. Bishop Museum of Honolulu, is now part of the training of the Ranger and Combat School in Hawaii, whose function it is to prepare picked men for commando action. It came about in this way.

After the Battle of Midway, when Hawaii could breathe easier and we at Bishop Museum had finished the job of mimeographing manuscripts and putting specimens in what we hoped were safer places, we had frequent opportunities to meet and talk with men heading southward. It was soon evident that our experience on expeditions and our knowledge of fauna, flora, and native means of providing food, shelter, and comfort would be of inestimable value in many situations. The stories coming in from fliers forced down at sea or in the interior of islands prompted us to volunteer to talk to crews about to go into action over the island areas.

For reply, two officers were sent to me at Bishop Museum to obtain information to incorporate into a "Castaway's Baedeker to the South Seas."* Mr. Edgar Schenck, Director of the Honolulu Academy of Arts, heard of this and conceived the idea of my putting on at the Academy an exhibition, "Native Lore for Castaways in the South Seas." This took place in January as a joint effort of the two museums. From the start we were swamped with requests from various air units for gallery talks and demonstrations in the court where a sample camp site had been set up. The exhibition was moved to Bishop Museum, where interest has continued unabated.

As a result of the possibilities opened up by the exhibition, the Ranger and Combat School asked Bishop Museum to organize and supervise a course in "jungle living." An experimental group of eight officers and men was assigned to me for a short, intensive course. At the end of a week of instruction at the Museum, I took the class out onto the shores where conditions most nearly approximate those in the South Seas. They were introduced to the plant and animal life of reef and shore, and shown how these resources can be used towards solving problems of food, shelter, transportation, and maintenance.

After this, the men put on a demonstration for the whole school, simulating what they would do if sent on an island patrol. They appeared loaded with the food they would have picked up on the way—pandanus fruit, breadfruit, bananas, papayas, taro, yams, sweet potatoes, ti-root, sugar cane, tropical almonds, kukui nuts, and coconuts—, loaded into baskets of coconut leaf they had plaited themselves and with some of the baskets slung on carrying poles. The spot where they stood was to be the camp site. A ground oven was prepared, ignited with a coconut husk which had been carried along, one end smouldering, from the hypothetical last camp. The husk punk was given to one in the audience, who passed it for all to light cigarettes, thus illustrating how to conserve matches.

While I talked on the virtues of the various foods, the men prepared them. Sprouted coconuts were husked on the flat, sharp point of a straight stick thrust in the ground. Spectators were served the base of the sprout, "millionaire's salad" in embryo, as well as the delicate *uto*, or marshmallow-like growth that fills the space once occupied by the fluid of the coconut. The half shells with their lining of coconut meat were laid out in the sun to dry. This dried coconut meat, or copra, would serve as reserve food, or after grating it, oil could be pressed

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*Printed by the Objective Data Section, Intelligence Center, Pacific Ocean Area, Pearl Harbor, Hawaii.

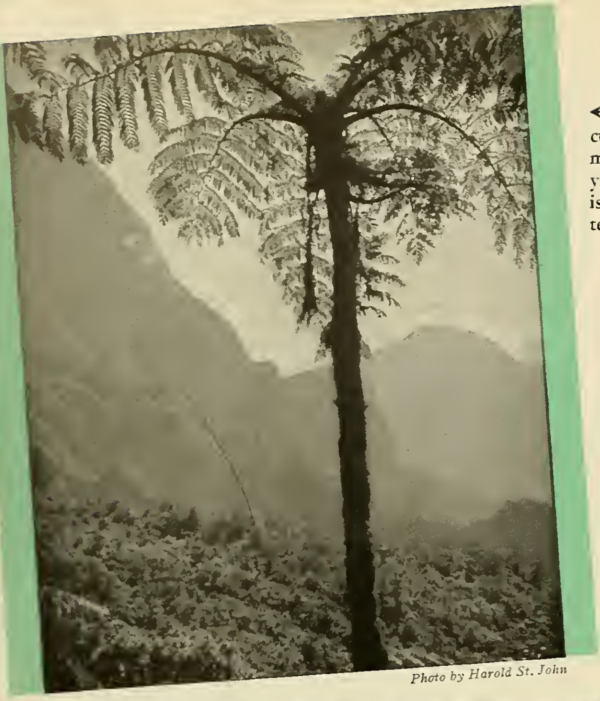


Photo by Harold St. John

◀ ITS FRONDS taste like cucumbers: a tree fern which might not be supposed to yield food but does and is easy to spot in the interior of many islands

out for relieving sunburn or preventing knives and guns from rusting. Pieces of this dried meat, impaled on a coconut leaflet midrib, made a perfect candle.

Mature coconuts were husked in less than a minute, split evenly in half by a blow with a stone on the center of the rib running midway between the "eyes," and shredded into a heap of snowy white particles. The grater was made of coconut shell. With a pocket knife the shell was edged with teeth and then firmly lashed by a strip of bark to the end of a small log raised off the ground. The grated meat was caught in a neat platter of green coconut leaf and squeezed over a coconut shell for its rich and tasty cream.

The foods were wrapped in ti-leaves, placed on banana leaves laid

▼ "MILLIONAIRE'S SALAD": the soft, white core within the base of the head of coconut leaves. A small tree like this will feed six men

Yank Photo, by John A. Bushemi

Yank Photo, by John A. Bushemi

on the nest of hot stones in the oven, and covered over with leaves and earth; then the second act began. This was the setting up of a shelter made entirely of coconut leaves. Thirty green leaves served for the thatching of this house, which was erected by six men and was capable of accommodating them. I demonstrated how a leaf thatch could be plaited in two minutes, while the men put up the frame of the house. The thatch was then tied on, beginning at the bottom, pairs of thatch sheets overlapping each other at intervals of six inches. In less than half an hour the house stood completed, floored with sleeping mats of coconut leaf, closed in at one end with leaf screens and at the other end with a mosquito netting of coconut cloth (leaf stipule).

Before opening the steaming oven to serve hot sweet potatoes, yams, bananas, and breadfruit to be dipped into the cups of coconut cream, one of the men showed how he would prepare himself to go out onto the reef to collect shellfish. He made himself

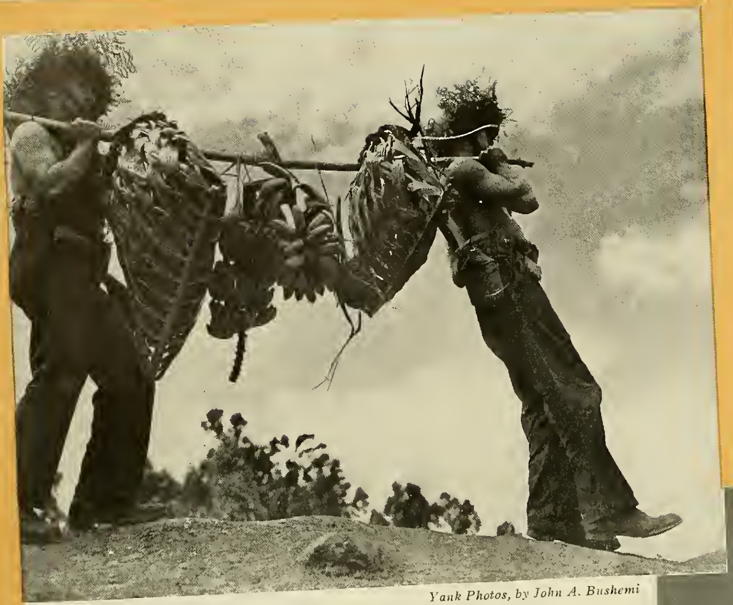
▲ PAUSING by a stream to roast a breadfruit over coals

➤ NEITHER STARVATION NOR STOMACH-ACHE: the author informing a student how green bananas can be eaten if baked in the ground oven

Yank Photo, by John A. Bushemi

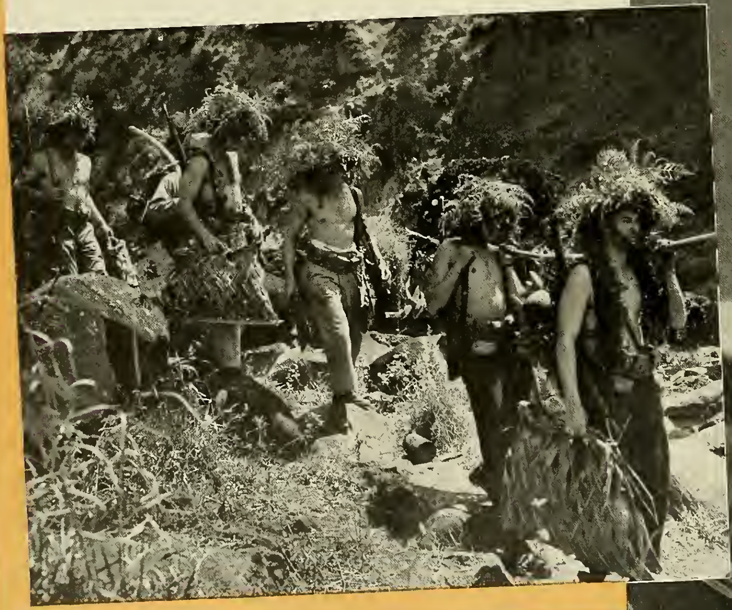
a coconut leaf eyeshade, a pair of hibiscus-bark sandals, a loin cloth of coconut-leaf stipule, a satchel of coconut leaf. Smearing himself with coconut oil, he set forth, the satchel and a drinking nut hanging from his belt, a husking stick in hand.

These were some of the main points of the demonstration. In the week following, the whole school was taken out to an ideal location and the instruction received by the special class passed on to all. Stress is constantly put on the fact that the techniques they are taught and the knowledge given come originally from natives, and that it is greatly to their advantage as soon as they are on an island in the South Seas to contact natives and add to the foundation for tropical island



Yank Photos, by John A. Bushemi

▲ Bringing in food picked up while on the trail, with the aid of baskets made quickly on the spot

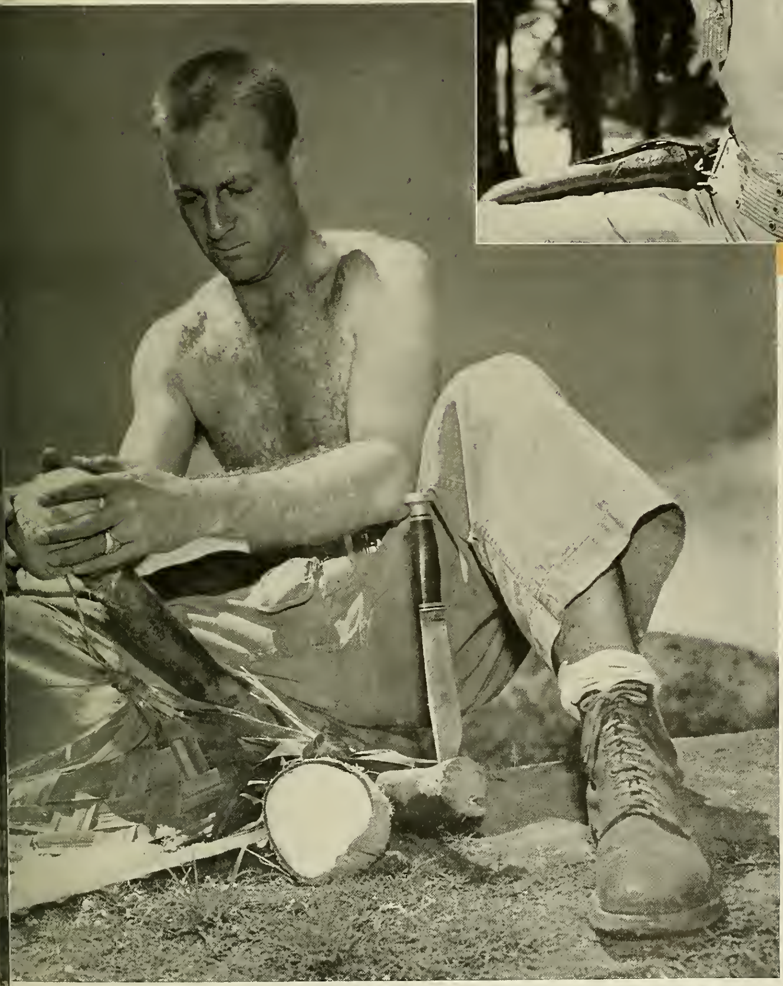


▲ The class in island adaptation coming in from a trip on which they have plaited their own baskets and camouflaged their helmets with fern wreaths

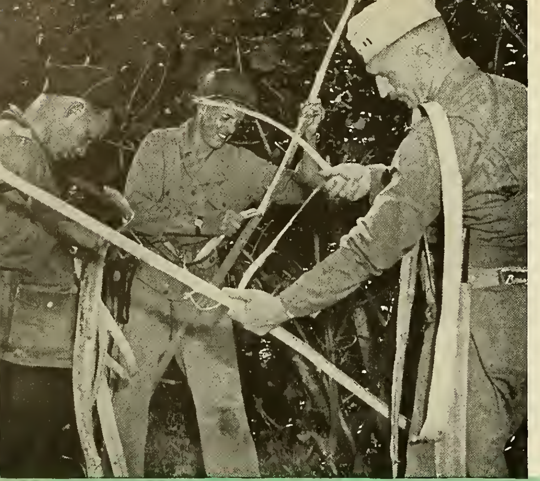
living given them while in Hawaii.

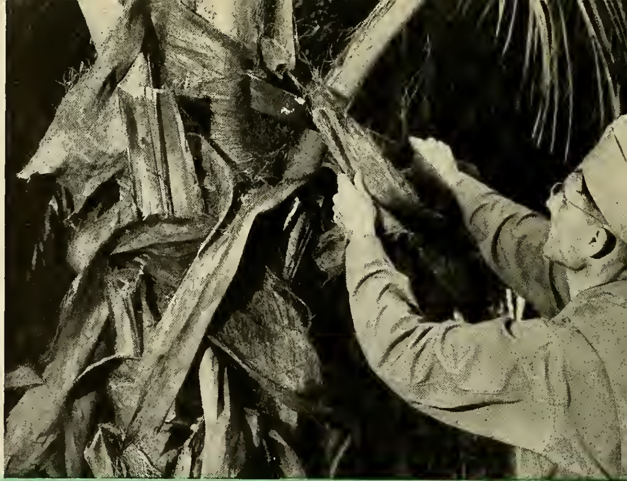
The skills they have acquired are a source of pride, and the practice of them a recreation. The men are also taught what fruits to avoid, what fish are likely to be poisonous, how to use certain plants for cathartics, astringents, germicides, and antidotes for fish poisoning, and how to negotiate reefs without being knocked down by waves, cut by coral, or nipped by a shark. An unlooked for result of this preparation is an entire change in the attitude of the men who face the prospect of fighting in the southern islands. Dread of the unknown and boredom of waiting are replaced by lively anticipation and the pleasure of learning to be self-reliant in a world new to them.

▲ A LOAD of mature coconuts to be husked and grated for coconut cream



◀ GRATING the meat of a mature coconut. The grating tool is a piece of coconut shell edged with teeth by means of a knife. It is lashed with bark to the end of the stick. The snowy white particles fall on a coconut-leaf platter. Oil can be pressed from them to protect the skin from sunburn and prevent knives and guns from rusting





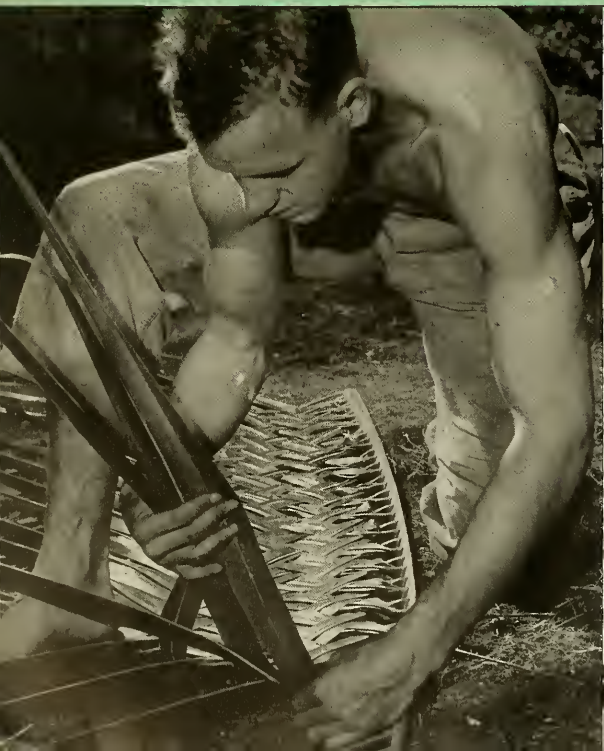
Yank Photos, by John A. Bushemi

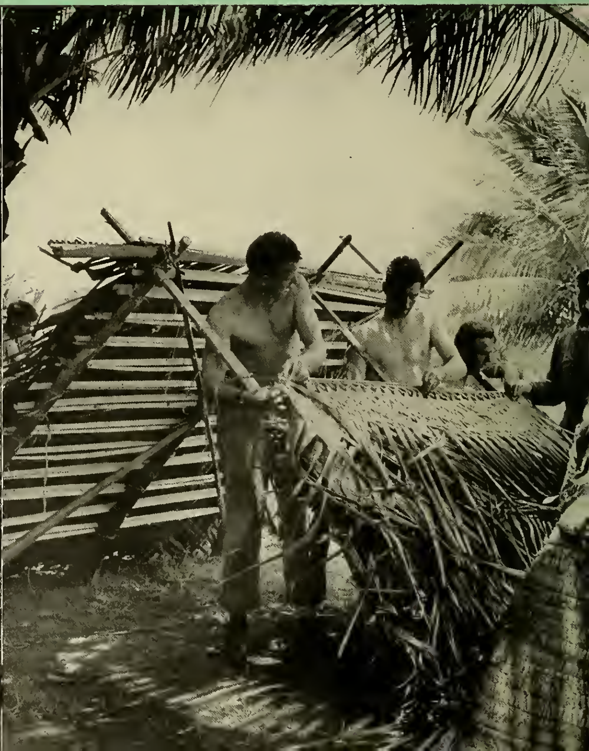
▲ Stripping wild-hibiscus bark for fibers which will be useful in making sandals, ropes, fish lines, and nets. The policy is: "In the South Seas, do as the South Sea Islanders do;" they have perfected their methods through generations of trial and error

▲ The author cutting coconut "cloth" from the base of coconut leaves. The castaway or reconnaissance man can use the cloth in many ways as a substitute for real cloth, even as mosquito netting. Strips of the material are woven into sandals. Pieces are sewn together, using the midrib of coconut leaflets as needle and thread

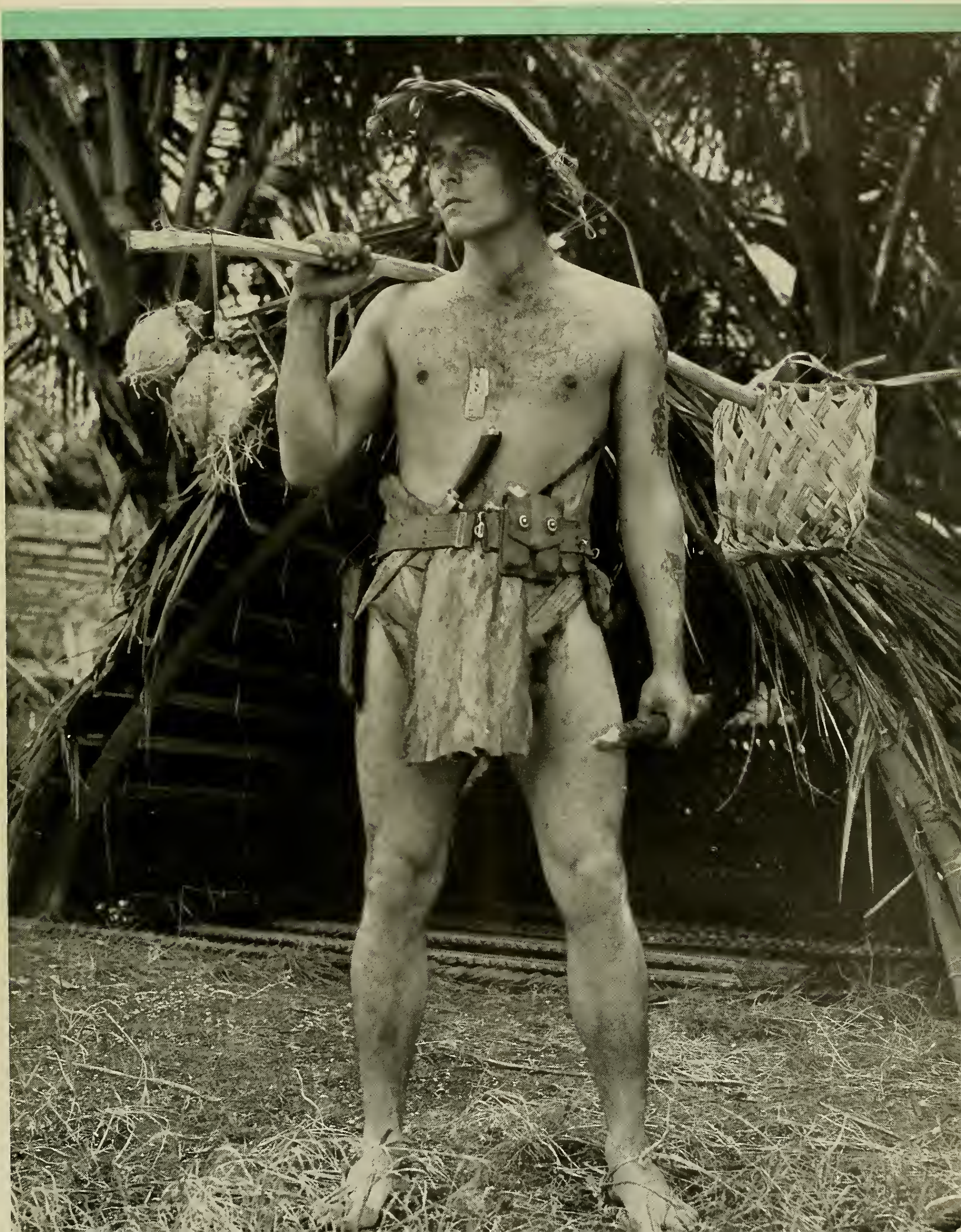
▼ Plaiting a coconut leaf for roofing, mats, or baskets. Every other leaf is turned backward and placed beneath the upraised under-leaves

▼ Building a shelter entirely of coconut leaves to accommodate six men. The frame is constructed of three pairs of leaf butts lashed together at the top, with a ridge pole made of a midrib. Thirty green leaves provide a thick double thatch impervious to rain and guaranteed for six months. The cordage for tying the frame together and tying on the thatch is strips of coconut-leaf stipule or the outer skin of the leaves. Pre-fabricated by Nature, the house can be completed in half an hour





▼ A GRADUATE of the "jungle" school, unencumbered by cap, gown, or diploma. Standing before a hut constructed by himself and his comrades, he is ready for whatever adventures may lie between him and the comforts of civilization. He has made himself an eyeshade of coconut leaf, a pair of sandals of hibiscus bark, a loin cloth of coconut-leaf stipule, a carrying pole, and a basket. Outfitted for a trip along the reef, his husking stick will serve to pry shells loose. The two young coconuts, husked, provide him with ideal drinking water. All in all, he gives convincing proof of the value of a "Castaway's Baedeker to the South Seas" and of the instruction being given by the Bishop Museum and the Honolulu Academy of Arts

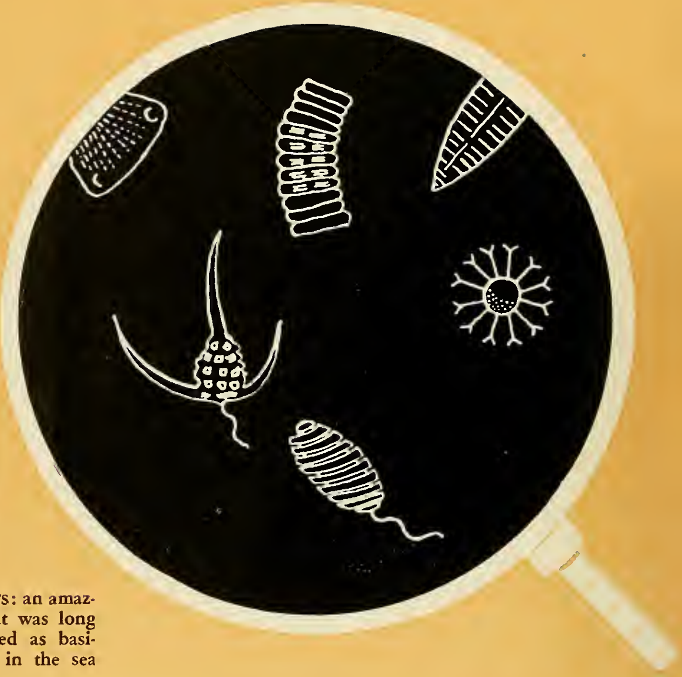


Pastures of the Sea

By ELON JESSUP

***Drawings by* G. MILES CONRAD**

Showing that the chain of life is no stronger than its weakest link and that even a whale may be helpless without a tiny "shrimp"



ONE-CELLED ANIMALS AND PLANTS: an amazing assemblage of water life that was long overlooked. Now it is recognized as basically the most important thing in the sea

THE modern version of Jonah, if less spectacular than the original, must still be classed as surprising. What does the whale actually eat? You listen attentively to the zoologist's answer. Logic, you decide, has once more turned topsy-turvy.

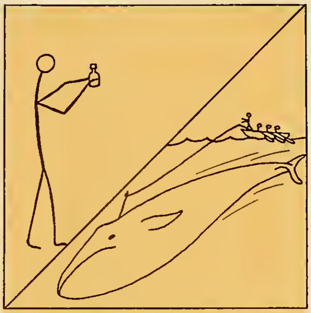
The whale's prevailing diet—if he happens to be a whalebone whale—turns out to be a tiny crustacean which you will need a magnifying glass to examine. Different kinds of whales prefer different varieties of these minute creatures, which in a very broad and important sense make up the "pastures" of the sea.

Far from living up to dimensional expectations for the diet of the largest animals alive today, one *pièce de résistance* of the whale world—one of the copepods—measures about one-twelfth of an inch in length. Maine fishermen gifted with good eyesight know copepods variously as "red seed" and "cayenne," owing to their color.

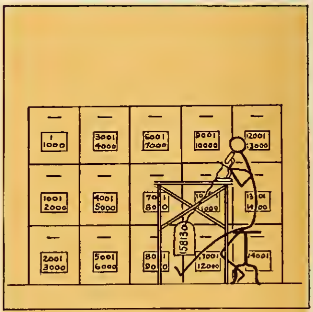
It is only the so-called Pollock Whale, otherwise known as the Sei Whale, that cares much for copepods, and it also consumes fairly large fish. Other whalebone whales such as the finback, blue whale, and humpback, display marked preference for the tiny shrimplike euphausiids, which are somewhat larger. Down Eastport way, it is said, the finback whale and vast schools of herring have been observed working on the euphausiids in what you might call shifts. However, since the finback isn't averse to a mixed diet, there are sometimes sad consequences for the herring. In safer territory, the herring have been seen practically climbing the Eastport docks to get at the euphausiids.

As for the copepods, they have other takers, even if the finback whale can't be bothered. Herring like them; and when schools of mackerel are feeding on them, the Wilson's petrels flying overhead apparently take advantage of the opportunity to make it a general feast.

Both the copepods and the euphausiids belong to that fabulously numerous assemblage of water life we have come to know as plankton—passively floating or weakly swimming animals or plants. To you and me, plankton may look pretty useless. But not to the zoologists. Basically, de-



THEY ARE SO SMALL that a three-inch bottle can hold five million. Yet some of the largest existing animals live on them. They are the foundation of the food ladder



FISHERMEN interested only in big fish should realize that there would be no fish but for the plankton. More than 15,000 kinds have been catalogued from the sea clare the zoologists, these organisms are the most important thing in the ocean.

It must be granted that the number of different varieties is quite impressive, particularly since no one knew they were there until fairly recently. How the earlier zoologists overlooked the most important thing in the ocean is surprising, but modern scientists have obviously been industrious in making up for lost time. A total of 15,813 different species of marine plankton have been classified to date, and a great many more are probably on the way. Beyond this, the fresh-water plankton make another formidable list.

The whale's insatiable appetite for such tiny morsels throws the earlier oceanic feeding chart slightly out of focus. So does the similar taste shown by herring, mackerel, rosefish, and a number of other adult fishes. In its simplest form, we might expect the chart to designate plankton as the special food of the young, the birthright of the little fellows among all kinds of fishes.

However, when a fish is very tiny, investigations have proved that even a copepod will be declined. Some smaller form of plankton is then favored as diet. This is the one-celled diatom, a microscopic plant of which there are a great many different kinds.

Although a good many diatoms are needed to make a meal, the little fish has no need to go hungry if it picks the right place and season. Dr. Mary Sears, of the Woods Hole Oceanographic Institution, estimates the diatom population under a single square meter of water in the Gulf of Maine. Her estimate, it might be explained, was made during their time of greatest abundance in the spring. Abundant they were, indeed: between seven and eight billion diatoms under each square meter of water.

After a while the tiny fish grows bigger, becomes slightly bored with its diatom diet and develops a carnivorous taste. For a time the plankton community itself can satisfy this with, say, the animal copepod. But even a copepod isn't as much fun as eating real fish. As for vegetables, the fish has long since ceased to find any fun at all in them. There aren't many vegetarians among adult fishes.

That the copepod diet can give the young fish an ambitious start in life cannot be doubted when we see what copepods can do for a whale. It may come in pinhead portions, but when consumed in bulk this fare has what it takes. The copepod group alone includes at least 6,000 different species —certainly no lack of variety.

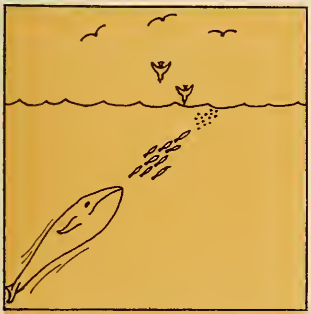
Some whales, as noted, concentrate on the euphausiids, another variously assorted group. But the young fishes are less particular. If it's plankton, it goes.

Plankton as human food

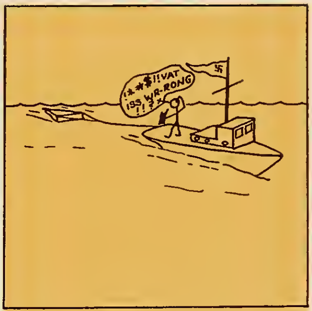
Now let Nature proceed along its way while we examine the case of man, for the whales and young fishes appear to be threatened with competition. Every once in a while you will hear of some tentative hope among mortals to capture this vast storehouse of plankton nutriment cruising the seas in countless small forms. One of the latest plans has seeped out of presumably leak-proof Germany. Nazi scientists have been reported to be preparing a big-scale netting offensive upon some of their newly acquired oceans with a view to turning the plankton harvest to good use in pepping up army and civilian diet. The Norwegian coast is famously thick in plankton.

Dr. George L. Clarke, of Harvard and the Oceanographic Institution, has troubled to make calculations upon these hopes. He grants that the drifting morsels are extremely rich in food values. Some of the small crustaceans exceed 30% in fat. He also points out that shipwrecked crews have been accredited with holding a handkerchief over the side as a net and thereby catching enough to subsist. But this latter point Doctor Clarke is inclined to question. His figures disclose that it would take two and one-half hours of steady towing under power with the most efficient type of equipment and under entirely favorable conditions to harvest a sufficient amount of nutriment to sustain one man for one day. This would entail the thorough coverage of at least 7,500 meters of water, approximately the area of a football field, to a depth of 1.5 meters. Labor and other details considered, he doubts the practical value of such a plan.

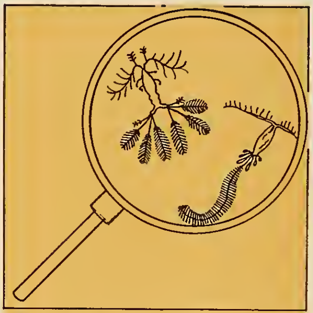
Of course, there is nothing new about netting the seas for plankton. On our own coastal waters and in various other parts of the world, collecting has been progressing for years, sometimes on a considerable scale, as in the case of the Oceanographic Institution's fine research ship "Atlantis," which periodically puts to sea



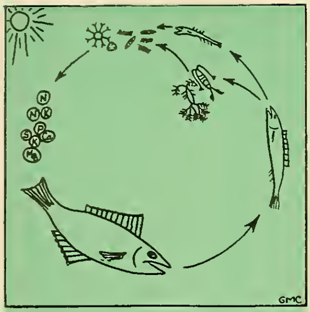
Both herring and finback whale relish the small shrimp-like euphausiids. Sea birds as well are often attracted to a scene like this—for a fish dinner



Reports say Nazis plan to harvest the pastures of the sea for human food. Estimates of man-hours needed for a square meal would seem to dash their hopes



These weakly swimming or passively floating organisms are all called plankton. The animal forms are apt to be larger than the plants, on which they sometimes feed



Big fish eat little fish; little fish eat tiny animals and plants. The tiny animals feed on the tiny plants. The plants need sunlight and inorganic nourishment

from Woods Hole, Massachusetts, for a two weeks' plankton cruise.

But all this, naturally, is along research lines. It appears that plankton collecting for personal consumption will not threaten the whale in the immediate future. Meanwhile, you and I, without always being aware of the fact, continue to benefit greatly from the plankton in indirect ways.

A fish story from the sea-going locality where I happen to live will illustrate the interlocking chain of life in which the pastures of the sea form such an important link. Here a rising generation of Cape Cod market fishermen, aged 10 years and upward, will now and again approach a resident scientist with offerings. This time the offering turned out to be a big weakfish.

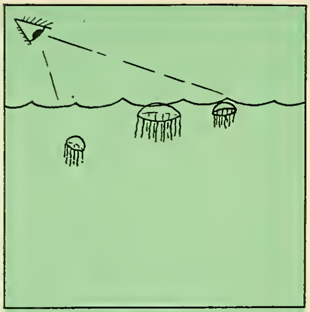
The scientist eagerly slits the weakfish open to see what is inside. He finds to his slight surprise quite a respectable size herring. Well, what could the herring have eaten? It turns out that the herring, evidently off its plankton diet, has consumed a young scup. And what would a young scup eat? This time we find a collection of copepods.

The situation now becomes a trifle involved. A two-millimeter copepod doesn't offer much to dissect. But even a copepod must eat to live, and science must learn. An intimate examination with a microscope, attached to various parts of the copepod's person, discloses an assemblage of diatoms.

As to how many diatoms were present in this case, I cannot say. But one of the scientist's colleagues, during a similar examination of a copepod, reported a count of 200 diatoms, together with about as many more of another group of microscopic plants known as peridinians. That is slightly higher than the count for a drop of water. One drop of water is credited with holding only 200 diatoms.

These diatoms differed fundamentally from their predators. They were neither fish, flesh—nor good red copepods. Although as plankton they belong to the same over-all category as copepods, they are still basically different. Copepods are zooplankton—that is, they are animals, meat. Diatoms are phytoplankton — vegetable matter, plants. Being plants, they are able to elaborate inorganic matter to form the organic matter of their bodies, while their animal neighbors can only break it down again to the inorganic condition.

The investigation couldn't go any further. Excepting the peridinians (dinoflagellates) and other groups of microscopic plant life less numerous than diatoms, there wasn't anything more left in the ocean to eat. In the diatom our investigator reached both the end and the beginning of the chain, the base of the pyramid. He had come to the producer of the primary food supply for all inhabitants of the ocean —which would appear to be quite a responsible position to be held by something you can't even see.



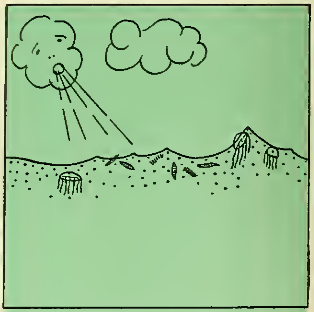
Some animal plankton are large enough to be observed with the naked eye, such as the jelly fish. Early in life, sea urchins and starfish are plankton, but not later

To be sure, even the diatom must have had some means of keeping alive. But to find that out we would have to investigate the fertilizing nutrient salts in the water itself and the powers of energy in the sunlight pouring down from overhead. So instead:

"All flesh is grass," our scientist cryptically reflects. "And all fish is diatoms." If not diatoms themselves, other similar kinds of one-celled plants are at the foot of the food ladder. This, in brief, is the zoological story of ocean life. Scup and weakfish couldn't have existed unless there had been a diatom or comparable microscopic plant to nourish the animal copepod, which in turn became a hearty meal for the hungry fish. Or, to introduce a slight but important variation, there wouldn't be any cod or haddock for your dinner if cod and haddock, following their own bottom-feeding inclinations, had not gorged on mollusks, which concurrently were gorging upon diatoms.

No matter how many variations you bring in, it always seems to come out the same. "Fish is diatoms."

These many different kinds of small plants and animals have an upsetting effect upon preconceived views. As an example, there are the great masses of familiar, visible plant life in the sea. We have all seen them in one form or another, cluttering up or beautifying the tidal waters near any shore as the case may be. The immenseness of what this might represent in total bulk staggers the imagination. But a plankton specialist steps forward with the disillusioning information that all this really doesn't amount to much. Helpful, yes, but as a contribution to the ocean food situation as a whole it is of minor importance, you might say inconsequential. It is not the plant life you see but rather what you don't see that matters—the microscopic plant life, drifting out yonder, which constitutes to an overwhelming extent the edible vegetation.

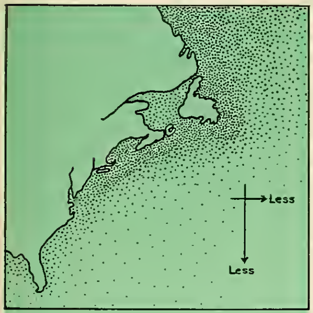


Wind and tide are chiefly responsible for movement of plankton from place to place. A form that gains respectable powers of locomotion loses its plankton status

On a summer day's sail you may have been aware of the existence of plankton without knowing exactly what you were looking at. The sea, you noticed, was no longer a clear sky blue but had turned to a soupier olive green. There were your plankton, stretching perhaps for miles in every direction, untold millions of living objects. In the laboratories of the Oceanographic Institution I was recently handed a bottle about three inches high—estimated contents, 5,000,000 plankton.

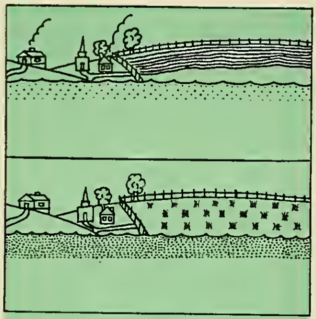
Or, perhaps you have found it fun at the seashore in summer to swoop here and there with a hand-net. You haven't caught plankton; they've run through the net. Substitute close-woven silk in place of the coarser net and, provided an onshore breeze is blowing, the chances of making a fairly substantial haul of plankton are in your favor. After a scoop you will observe, shining in the bottom of the net, a gelatinous film which exudes a faint fishy smell. There they are.

In the Gulf of Maine, Dr. Henry B. Bigelow, of the Harvard Museum of Comparative Zoology, reported that there were an average of 30,000 to 40,000 copepods alone under each square meter of surface water. In the same region Dr. Alfred C. Redfield, reporting on the findings of the research ship "Atlantis," gives some astonishing intimations of the total plankton content. The area of the Gulf of Maine is estimated to be 36,000 square miles. Of course the plankton population varies with the season. Doctor Redfield first figures what he defines as the "standing crop" of copepods—the stock on hand, or the population before it has been increased by new growths. His estimate of this is four million tons. It corresponds to the quantity of grass standing in a meadow where cattle are grazing. Between May and September the growth of this standing crop will have yielded eight million tons of copepods. This, you will understand, is from the Gulf of Maine alone.



Plankton population is thicker close to shore than 100 miles out. Commercial fishermen have long known that fish obey a similar rule—no mere coincidence

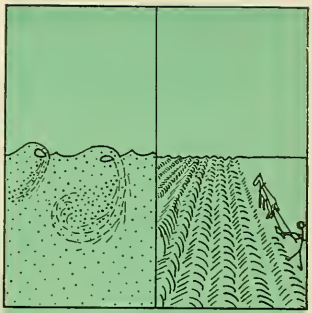
First and foremost the plankton constitutes a drifting world. That is the literal meaning of the name plankton, a word borrowed from the Greek, meaning the wanderers, drifters. Forms of ocean life that can swim, crawl, creep, or are otherwise gifted with special powers of locomotion really don't belong. To be sure, even some of the microscopic plants are capable of feeble attempts at self-propulsion. The diatoms, which are by far the most numerous, remain completely passive, but surprisingly enough we find the dinoflagellates engaged in a sort of miniature fan dance. However, all such efforts are extremely feeble in comparison with the movement of fishes and other creatures of the sea.



Like a cultivated field, plankton pastures of the sea change with the calendar, but Nature does all the work. The abundance varies greatly with the season

There are drifters of considerable size—jelly fish, suggestive of parachutes. Because of their essential aimlessness, these too are included in the plankton community. But it is the very much smaller forms of life that predominate. In many instances the plankton status is only temporary. Sea urchins, star fish, worms, and other organisms belong with the plankton while they are larvae, but when they develop they no longer qualify.

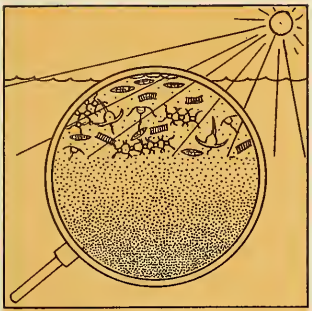
Like the clouds in the sky, which it often resembles, the plankton world is subject to constant change. At one time you won't find a single diatom. Then of a sudden in the spring there will be a tremendous "flowering," and the ocean will be teeming with diatoms, literally billions of them under a single square meter of water. Within a month the diatoms will again have vanished, giving place in summer to a rich peridinian flowering. Zooplankton also fluctuate markedly, though to a lesser extent. Doctor Bigelow, while making towings in the Gulf of Maine, would catch only 30 or 40 cubic centimeters of them each haul at the end of February or early March. Months later he would catch 400 cubic centimeters at a haul. Doctor Clarke after several expeditions along the Continental Shelf concluded that the plankton was 20 to 40 times more abundant during the warm half of the year than in the cold half.



The waves of the ocean mix the nourishing elements for the pastures of the sea, much as a plough does when it turns over the soil in a field

He also found the plankton to be four times thicker fairly close to the coast than at a distance of 100 miles out. There seems to be general agreement that the farther toward mid-ocean you go, the scarcer the plankton becomes. Commercial fishermen have long been aware of much the same ratios guiding the presence of fish. Obviously, more than a coincidence.

Ocean currents are to be held responsible for horizontal rovings of the plankton, and great rovers some of them turn out to be. Despite their limited powers of locomotion, they seem to manage vertical movements as well. Some mysterious stimulus, still unexplained, will cause them to sink and rise, in some cases as a regu-



The plant forms require sunlight, so anything forcing them too deep is apt to kill them. But most can produce resting spores which can survive darkness for a time

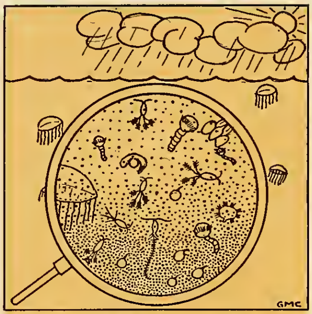
lar habit. Doctor Bigelow found that the copepods invariably would rise to the surface at sunset, where they would remain until midnight, and then sink again quite deep.

Between the surface of the water and 100 meters down is the realm in which most of the plankton are netted. Zooplankton from as deep as 500 meters and more have been studied. But here we find a remarkable point of difference between the animal and the plant forms. Zooplankton can take it. Phytoplankton cannot. Being plants, they will perish if they lose complete touch with the sunlight overhead. When they sink too deep, they stop producing. To be sure, most of them are able to form some kind of resting spores which, when brought up to the proper level, produce new individuals. But depth is a much more crucial factor in limiting the distribution of phytoplankton than it is with zooplankton.

To the plankton world in general, unavoidable accidents occur. The mortality rate, as already suggested, is tremendous. Something a little bigger eating something a little smaller accounts for a considerable share. You will recall that a copepod can easily accommodate 200 diatoms. As for the number of copepods a whale and vast schools of herring and mackerel can stow away, imagination falters. Then, too, an occasional disrupting storm will scatter and destroy great numbers.

Yet, contradictory though it may appear, such scattering may instead turn out to be a saving grace. It has been noted that on the heels of a hard and blowy winter an exceptionally rich and abundant plankton crop may follow in spring and summer. On the other hand, after a mild winter with a fairly stable, undisturbed ocean, the plankton crop inclines to be scantier. And with this scantiness the fish crop itself may fall short of expectations. The remarkable failure of mackerel in the spring of 1937 is a case in point.

Plankton specialists can give you reasons. Down in Davy Jones's locker lies a peculiar type of treasure—fertilizer in the form of extractions from dead plankton and fish excrement that had been plankton. This must be stirred up and distributed, carried up and about to where it will do the most good. What is literally a manufacturing process then begins. Nitrates and phosphates in the water combine with energy supplied by the sun to produce new growths of phytoplankton. Before long the ocean is once more teeming with microscopic plant life.



Animal forms, on the other hand, do not need sunlight as the plants do, so their range is not limited in this way. Specimens are found 500 meters or more deep

It is a cycle that will not sound entirely unfamiliar to a tiller of the soil. It is the reason why we think of the plankton as the pastures of the sea.

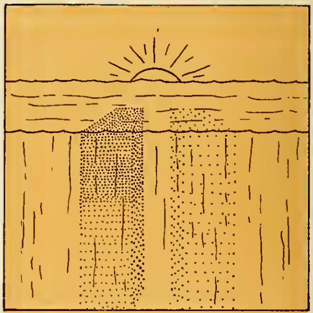
So, here we have far vaster stretches of rich grazing than probably could ever exist on land—and of which you and I frequently partake as the eventual consumers. "All fish is diatoms," no matter how you take it, even though a mollusk on the bottom of the sea has been the diatom's original consumer.

The importance of these relationships seems recently to have gotten through the conservative shells of Down East market fishermen. Erratic habits of mackerel, for one thing, have long kept them guessing. Why did the mackerel arrive in waters south of Cape Cod thin and poor? Why did they or didn't they hit a given stretch of coast at a certain time? Not that plankton research can show the fishermen how to catch fish where there aren't any. But at least it can throw sidelights that may help a lot in the end. An instance will indicate.

Doctor Redfield speaks of the connection between the arrival of mackerel in the Gulf of Maine and the presence of plankton in the same areas. A great counterclockwise eddy is involved, operating around the Gulf and moving at various rates up to seven miles a day. Three months are required for the complete circuit. Plankton, naturally, hop aboard (they can't very well help themselves), there to drift, live, die, and be recreated.

It is along the southerly shores of the Gulf, usually in June, that zooplankton become spectacularly present, chiefly copepods. At the same time, mackerel arrive and are caught in great numbers. Soon after, the copepods steadily diminish. The zooplankton again become abundant in late summer, but this time in a different locality — along the northerly shores of the Gulf and in the Bay of Fundy. Coincidentally the schools of mackerel put in a second appearance, not as previously on the southerly shores but on the northerly shores, where zooplankton are now abundant. The correlation appears to be complete.

This Gulf of Maine eddy is apparently quite beneficial. There are others that are detrimental. C. O'D. Iselin, leading authority on ocean currents with the Oceanographic Institution,



The plant forms vary in abundance with depth somewhat as shown above in left-hand column. The animal forms are more evenly distributed, as in other column suggests that the success or failure of an entire year's class of market fish may be closely related to the fluctuating strength of the Gulf Stream. He points out that suction eddies periodically appear along the northern edge of the Stream as the strength of its flow decreases. These eddies are thought to be peculiarly destructive to plankton and young fish. Although the whims of an ocean may be difficult to alter, it is useful to know when the whims are coming. And these appear on the way to becoming predictable.

Then there are the storms at sea. Destructiveness in this case appears to hinge largely upon the direction in which the plankton are carried. The Boston Fish Market now and again mourns a spectacular drop in haddock catches. Some of the plankton authorities explain it by saying that a year's class of young fish and the plankton have been swept off the banks down into deep water.

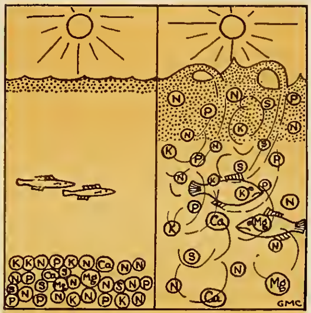
Marked disasters of this sort are fortunately rare. It is the natural habit of the water of Georges Bank, for example, to stay where it is, over Georges Bank. Plankton, fish eggs, and young fish remain relatively undisturbed. It is an ideal setting for propagation. That is why Georges Bank is a famous fishing ground. But once every few years there comes a variation in the volume of the Gulf Stream that sweeps young fish and plankton off into tremendous ocean depths and destruction.

Scientists argue quite understandably that if the food supplies of the fishes can be increased and maintained, we shall all get more and better fish. Much of the plankton research has followed this practical slant. It is more particularly true of investigations being conducted on inland waters. For in fresh water as in salt, "All fish is diatoms." Although numerous species of fresh-water plankton differ from the marine forms, the general problems are basically the same.

ANIMAL FORMS are plentiful in the southern part of the Gulf of Maine in June, and so are mackerel. Late in summer both arrive in abundance in the north

Let us inspect a fresh-water scene where the existing native plankton have never enjoyed the privilege of any outside help. Studies in this direction were made on a number of Minnesota ponds. Black bass were introduced to them, and a census of fingerlings taken to determine the potentialities.

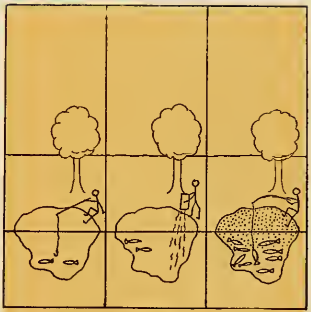
One pond produced less than 100 fingerlings to the acre. This pond was found to be extremely poor in plankton. The highest score was reached by a pond producing from 6,000 to 9,000 fingerlings to the acre. This one proved to be remarkably rich in plankton. Like ratios held all the way through.



STILL WATER is poor in plankton, and the fish go hungry. Movements distribute the food all along the line, and the fish thrive. But strong storms can be unfavorable

An important discovery shared by both marine and fresh-water research has led to further experiments. Not only could you raise plankton in the laboratory, but, like blades of grass, you could rear them right from scratch, even where they hadn't existed before. All they asked was nutriment and sunlight.

It was chiefly the fresh-water laboratories that carried on from this point with the introduction of actual fish. You couldn't do much about an ocean. It was too big and unwieldy. A fresh-water pond was different. Here, progress could be watched and definite results recorded. The laboratories moved out-of-doors.



IN FRESH WATER these tiny organisms are equally important. Addition of nourishment, such as cottonseed meal, will increase them. Fish then increase enormously

An example or two will illustrate the trend in results. At a Government hatchery in the South the fry of black bass made their appearance in one of the ponds toward the end of March. The pond was then fertilized to encourage plankton growth; about 50 pounds of cottonseed meal were added once a week. The water presently teemed with phytoplankton.

Toward the end of May—after only two months of growth—the average length of the bass was two and one-half inches. At least four months and possibly six would have been required to achieve the same growth without the added crop of plankton. Furthermore, there were appreciably more fish to the acre than in ponds not fertilized, and the fish looked better fed.

Experiments carried on by Dr. E. V. Smith and H. S. Swingle at the Agricultural Experiment Station in Auburn, Alabama, disclose further interesting comparisons. Two ponds were observed under fish-rearing conditions that were similar except that one was fertilized to encourage plankton growth and the other was not. The plankton-filled pond yielded a total fish production of 578 pounds to the acre, whereas the unfertilized pond yielded only 154 pounds.

Fish can't live on water alone, or exclusively on other fish. And if the water happens to be crystal pure, the pickings are nil. Bullrushes and pond weeds in abundance don't seem to fulfill the requirements, although they are obviously good for a flourishing mosquito colony. Something else is usually definitely essential. Fish need their diatoms or other microscopic life.

The Northern

Have you ever seen a sea otter at close quarters? Probably not, for there are none on exhibition at any of the zoos or aquariums in this country. Few museums even have a complete skeleton.

The sea otter (*Enhydra lutris, Linn.*) was first discovered in the Aleutian Islands by the early Russian fur hunters. Vitus Bering's ship, the "St. Peter," was wrecked in 1741 on the island now known as Bering Island, while returning to Kamchatka after his voyage of discovery to America. Here the survivors found many sea otters. These animals at first were unafraid of man, and the shipwrecked crew were able to kill them quite easily with clubs, in order to use the meat for food and the pelts for building shelters. On returning to the port of Petropavlovsk after seven months on the island they took with them over 700 sea otter pelts. The arrival of these furs in Russia led to other expeditions in search of sea otters, and so it was, traveling eastward from the Komandorski Islands, the animals were discovered in the Aleutian Islands. In the mad rush to secure these valuable pelts the Russians killed both male and female alike, sometimes even the pups. This almost brought about the extermination of the sea otter, as happened to the sea cow by the year 1768.

The adult sea otter is a sleek-looking, playful sea mammal with a flattish head, small ears, long whiskers, and a strong, thick, medium length tail. It has an over-all length of between four and five feet, and weighs from 45 to 70 pounds. The pelts give the appearance of having come from a much larger animal, as the skin hangs in loose folds on the body, and in the process of drying and tanning they stretch considerably.

In color the fur runs from a deep brown to jet black, the under part of the body and neck being of a lighter shade. Often the guard hairs are silver-tipped. The fur is soft, lustrous, and glossy on pelts in prime condition. Sea otters shed their fur at all seasons of the year. The pelts have always had a high value and today are worth approximately one thousand dollars apiece. Naturally enough these pelts are extremely rare, for these animals are now protected by the Government, none at all being permitted to be killed.

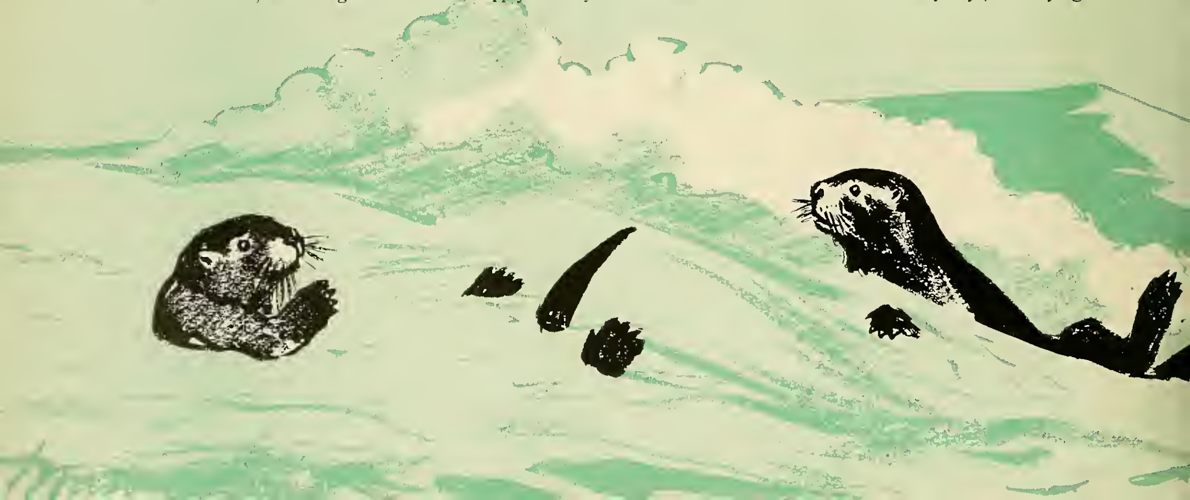
West of the Aleutians at Gladskuvskaya the Russians are pursuing an interesting conservation program for an animal which relatively few people have ever seen and which was once killed to the verge of extinction

The sea otter lives mainly on crustaceans, mollusks, octopuses, small fish, and seaweed. Because this source of supply is only found close to the shore, they are rarely seen far out at sea. The sense of hearing and their eyesight do not appear to be exceptionally good, but this is offset by their particularly keen power of smell.

Although larger than the land otter, the sea otter has characteristics of its land cousin and also those of the seal. It might be described as an intermediate between the two animals. The rear legs and feet of the sea otter are constructed on much the same plan as the flippers of the seal, and resemble a flipper more than a foot. Their front legs and webbed feet are used with great dexterity.

It is an odd fact that these animals also have some human characteristics, demonstrated by many of their actions. The manner in which they use their front legs and feet is one such characteristic, for they use them in the same way we do our hands and arms. A male will caress a female rubbing cheeks, or "kissing," and using his forefeet as hands in stroking the female. The mother sea otter nurses her pup at her breast in human fashion and also cradles her pup in her "arms" as do human beings. Mother animals have been seen to play with their pup by throwing it into the air and catching it again. One Aleut reported having seen them play with seaweed, tossing it into the air to catch it as it fell.

The early Russian fur hunters stated that a mother would protect her pup with her life. If the pup was killed and the mother escaped, she would return and carry the dead pup with her for many days, later dying of



Sea Otter

By ALAN G. MAY

sorrow or a broken heart. On the land the mother carries her pup by the nape of the neck as does a cat her kitten, and when angry the sea otter hisses like a cat.

Steller, the great naturalist who accompanied Bering, was the first white man to set foot on Alaskan soil. He described the sea otter as ". . . a beautiful, pleasing animal, amusing, and cunning in its habits." He reported that if some of these animals escaped into the sea after being chased by man, they would wave one "arm" in apparent derision at their pursuers. Sometimes they would hold one of their "hands" over their eyes to shade them in order to see better. When watching something from the water, they have the habit of rising vertically so that almost half the body is out of the water.

The molar teeth with which they crush shellfish are almost human in appearance, although somewhat larger. At irregular intervals the sea otters will migrate a considerable distance in large or small herds, returning to their own locality after an indefinite period of roaming.

They sleep in the water on their backs with their front legs in the air, jaw resting on chest, and the rear legs or flippers lying in the water to maintain their balance. When sleeping on the rocks of the shore, one of their number acts as guard to warn of any danger. They have few enemies, however; probably only the killer whale and sea lions. In groups or herds they are friendly and amiable creatures, never fighting among themselves. When playing they have a preference to be near large patches of seaweed, into which they dive, remaining under water from two to three minutes.

The swimming ability of the sea otter equals that of the seal or is possibly better. It is a real joy to watch these graceful animals sporting in the water. In play they seem to vie with one another in aquatic acrobatics, turning somersaults, rolling over and over like a spinning log, so fast that they appear like a whirling blur.

Like the baby seal, the sea otter pup must be taught to swim. The mother places the pup on her breast and takes to the water on her back, then gently pushes her offspring into the water. When the pup is tired or in difficulty, the mother picks it up and allows it to rest on her breast before repeating the lesson.

The figures on the sea otter herds of the Aleutian Islands are confidential. These herds, while not large at present, show every indication that with the full protection of the Government, they will be steadily increasing year by year. Although sea otters can be seen occasionally on almost any of the Aleutian Islands and also along the coast southward, there are two islands in particular which they frequent. These islands cannot be named, as sea otter poachers still exist. The Japanese knew of one of these islands and are known to have landed on more than one occasion and killed the animals for their pelts.

On Meydni Island, one of the Komandorski Islands under the jurisdiction of the Republic of Kamchatka, U. S. S. R., there is a little settlement named Gladskuvskaya where the Russians have established the only Sea Otter Experimental Station in the world. It was a great privilege for the writer to be able to visit this station in 1938 when working on an archaeological survey led by Dr. Alěs Hrdlička of the Smithsonian Institution.

Here, with the assistance of a few Aleuts, a Russian biologist is studying these interesting animals and also breeding them in captivity for the first time in history.

Gladskuvskaya is a small settlement of less than a dozen inhabitants with a few houses and a headquarters building which is used by the biologist as his laboratory and living quarters. Fine looking cattle and hogs roam at large around the buildings, while the Aleutian Blue Foxes, which are successfully raised on the island, are almost as tame as dogs.

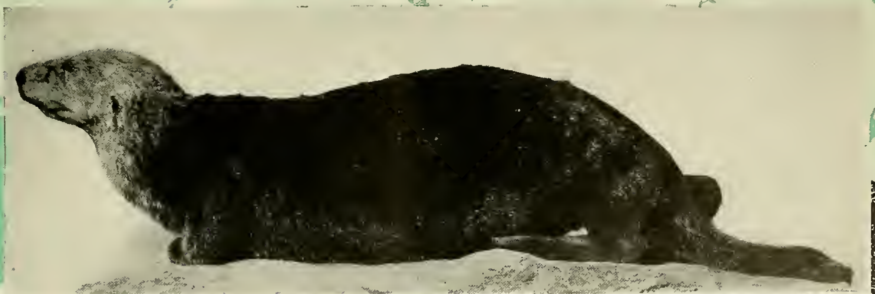
About a half mile from the buildings some large pens have been erected on a salt-water lake in which the tide rises and falls. In these pens the sea otters are kept segregated.

In order to determine whether the

Continued on page 47

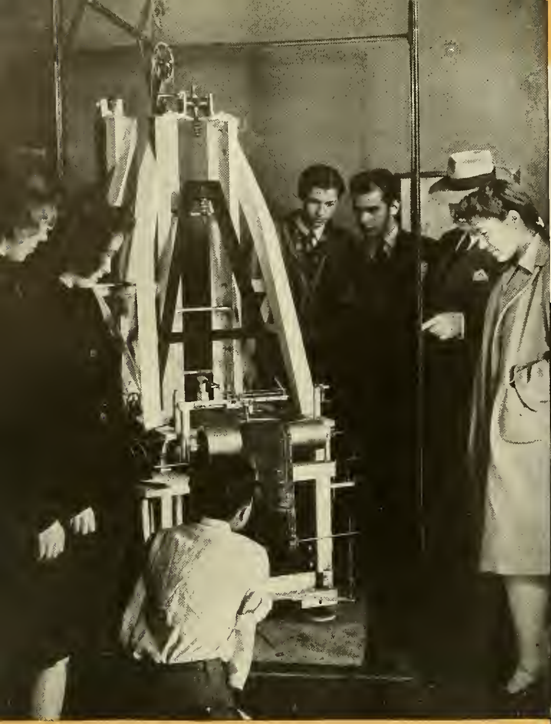
▼ A RARE EXHIBIT: one of America's few mounted specimens of the animal that has "flippers" like a seal yet resembles its much smaller land cousin. Sea otters weigh up to 70 pounds and are four or five feet over-all. The "$1000-pelt" ranges from deep brown to jet black, with guard hairs often silver-tipped. Strict laws forbid the killing of any sea otters

California State Division of Fish and Game; courtesy of California Academy of Sciences



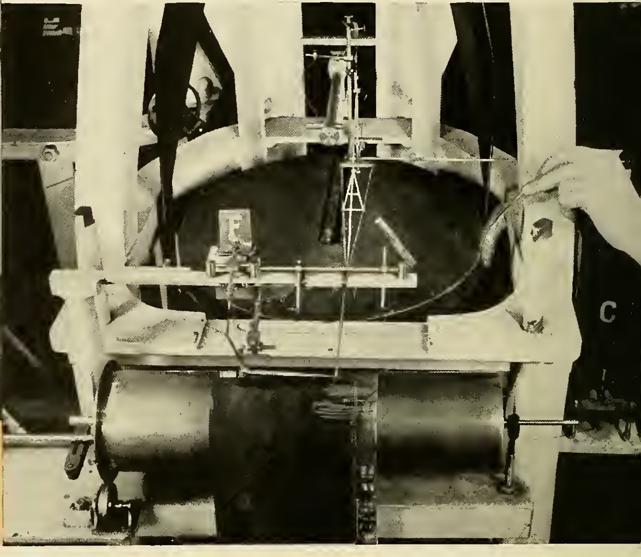
Recordin

The seismograph on display in the American Museum attracts much popular interest, especially when it is recording a quake—an occurrence by no means rare



A.M.N.H. Photos

▲ **Anchored** in bedrock, the instrument rests on an island of concrete that has no contact with the building. The Chinese invented an earthquake recorder working on the same principle in 132 A. D.



The seismograph is so sensitive that the touch of a feather will cause the needle to swing violently on the recording tape, as shown here. The tape is moved along day and night by clockwork

By Roland T. Bird
Department of Geology and Mineralogy,
The American Museum of Natural History

FOR nearly 32 years after the great Mino-Owari earthquake of 1891, a tranquil calm had rested lightly upon the islands of Japan. Aside from one or two sea waves of seismic origin that had swept in along the coast, nothing worse than a few stiff shocks had tumbled an occasional village or stone wall or tombstone here and there.

For one of the most unstable spots on earth, this was a long interval, but it was drawing to a close. Below the earth's thick crust, beneath deep Sagami Bay, countless earth particles pressed together a little tighter. Here tremendous forces involved in mountain-building uplifts strained at a 360-square-mile area, just beyond where Tokyo Bay opens into the sea.

In the busy, unsuspecting city of Tokyo, so close to this focal point of long-accumulated stress, a misty rain was falling. Women went about their tasks preparing a midday meal. In

Tokyo ablaze during one of Japan's disastrous quakes

Three Lions Photo

EARTHQUAKES

VHEN AN EARTHQUAKE
trikes Japan, it takes ap-
roximately 14 minutes
or the wave to travel
hrough the earth to the
ecording instrument in
New York City. Oscillat-
ng the supporting base,
his wave causes the en-
ire instrument to vibrate
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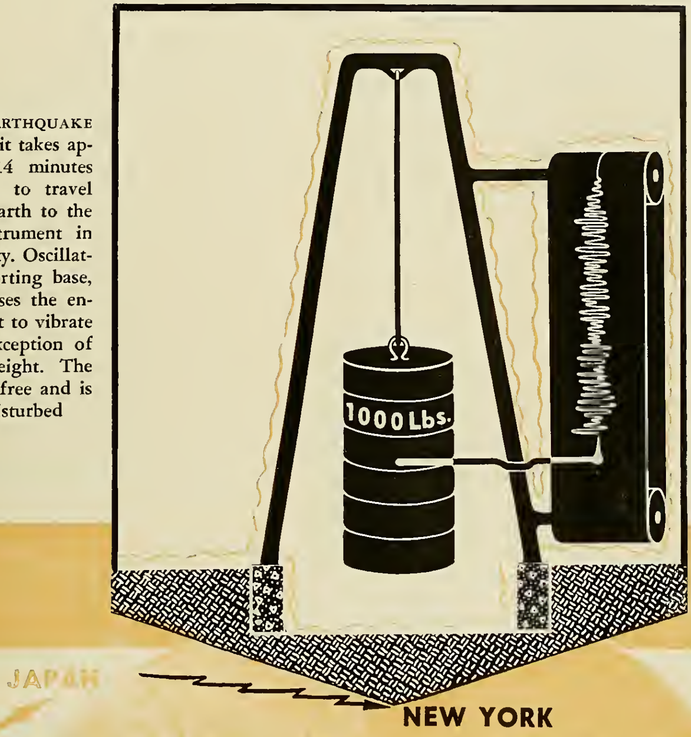
he heavy weight. The
veight hangs free and is
herefore undisturbed



The needle is attached to the weight. The recording ribbon is fixed to the base of the instrument and registers the vibrations after they have been amplified by a system of levers, omitted in this diagram for the sake of simplicity. The line traced by the needle on the revolving ribbon shows the exact time and nature of the shock

Drawing by John C. Germann

Yokohama, some 17 miles south, several tourists sat down to an early lunch, expecting to sail on a Canadian liner within the hour. Although a typhoon raged over the western islands, the day was not very different from any other in September during the previous decades.

It has been suggested that this typhoon may have "touched off" the quake. Just before noon an arm of the storm began to affect atmospheric pressures over Sagami Bay. Actually we do not know that this put into action the earth forces that strained so tensely below, but it might have.

In the bed of the bay, creeping fractures in the earth's crust spread over a wide area. These gradually increasing rifts traveled along lines of least resistance, often running many miles apart—forerunners of the great faults that were to split the bay's floor into several huge blocks of enormous depth and size. What was in store for the surrounding land?

Let us turn back the years, and visualize the rest of this story as it quickly happened. The time is approximately 44 seconds after 11:58. A deep grumble has just been heard from the tortured earth and windows rattle gently. In Tokyo many people instinctively hurry into the open streets.

Almost at once and without further warning, the city shakes to a subterranean blow so violent that it seems to crumple walls by the mere physical impact from below. Buildings surviving this first shock sway until people inside cannot walk across floors. Other shocks follow, and the first of several bridges slumps into the river Sumida, the Thames of Tokyo. Trees are uprooted, roads fissured, water mains fractured. Water floods some areas waist-deep. Like broken cobwebs, telephone and telegraph wires are left tangled on the ground or hanging from poles.

A panoramic view of Yokohama shows even worse destruction, for it is only 40 miles from the epicenter—the point directly above the focus of the quake. In the lower part of the city, buildings are collapsing in clouds of dust so dense a man cannot see his hands. The captain of a Canadian liner offshore saw, "the whole city billowing . . . houses and vehicles drifting . . . the next moment clouds of dust."

Piers splash down along the water front. The breakwater beyond sinks into the sea. The lighthouse at its end crumbles and starts to fall. Railroad tracks leading away from the city's rising dust look like coils of rope where the earthquake has twisted them.

In the rural areas along Sagami Bay, people standing on soft ground suddenly find themselves hammered into the earth knee-deep. Out on the Manazuru Peninsula potatoes are tossed from their hills, and on more than one farm the entire harvest is bumped about like balls. Equally fantastic, farmers' wells are seen to rise bodily from the badly pounded ground, their tile casings seeking positions of equilibrium sometimes eight or ten feet in the air, or collapsing in bits. In the bay large fish are killed by the compressive shocks. On nearby Mt. Tanzuwa about eight square miles of forest go crashing down; the destruction in this area baffles all description.

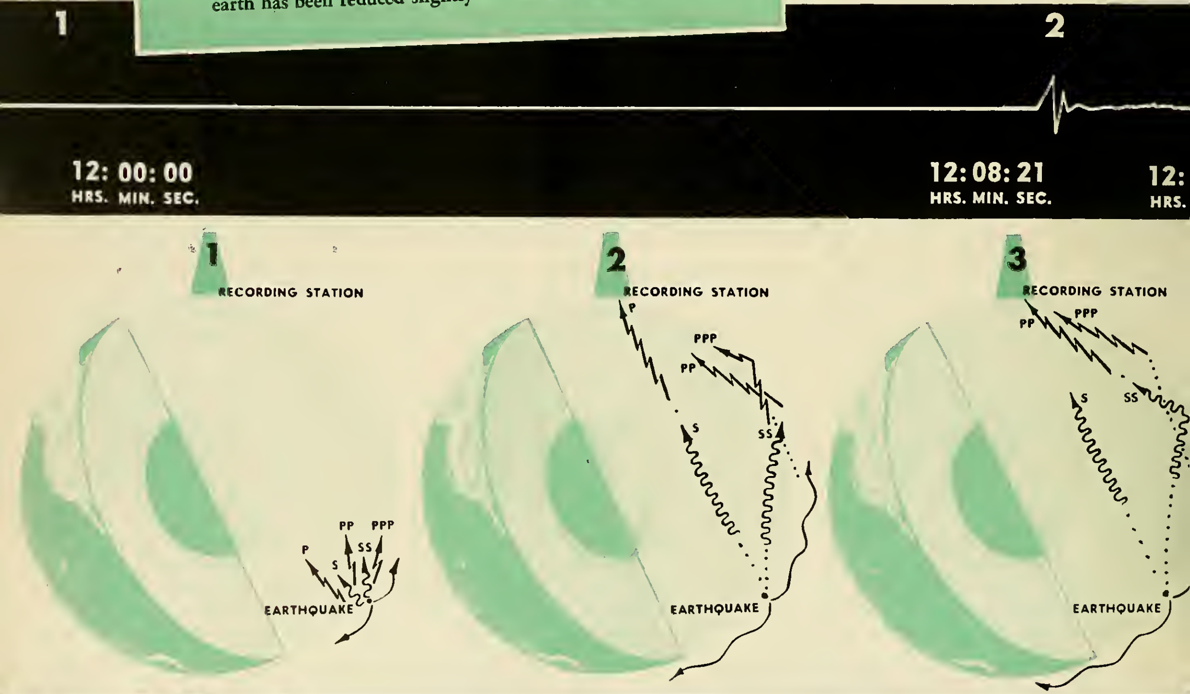
For 30 long seconds this violence persists. A moving locomotive and five passenger coaches are hurled from the track near Oiso. Another train not far from landslide-wrecked Yokosuka gets caught in a falling tunnel. Pushed and tilted from below, a section of the island has moved upward, as if to compensate for those forces of erosion that forever strive to wear down all land masses to the level of the sea.

Some of these huge crust blocks have tilted more than others as they rose, and a 24-foot uplift at Misaki connects Yoashima Island with the mainland half a mile away. Now the earthquake lapses sullenly into a long series of aftershocks, caused when most of the displaced crust blocks, having overshot positions of equilibrium, settle back from time to time.

We next witness the water retreating a hundred yards from shore along Sagami Bay. This mysterious event is caused partly by the recent uplift of the shore. Subsidence in the bay's center is another contributing factor, for it starts several cubic miles of water moving in from round about at the same time. When the sunken portion

How Far Away is a Quake?

1. The shock occurs at 12:00 noon, though those at the recording station do not know it yet.
2. The first "push" wave (P), moving faster than shear waves, reaches the recording station 8 minutes and 21 seconds later. "Push" waves resemble the first wave passing through a steel bar struck with a hammer. "Shear" waves are twisting, shattering vibrations.
3. A second "push" wave (PP) is reflected once on the underside of the earth's crust and arrives 1 minute and 41 seconds later. A third "push" wave (PPP), reflected twice, is due 28 seconds thereafter.
4. The third "push" wave arrives. Then there is a wait of 4 minutes and 35 seconds while the "shear" wave (S), slower than the "push" waves, follows the direct route.
5. The first "shear" wave reaches the recording station. Note that 6 minutes and 43 seconds have passed since the first "push" wave. This interval tells how far away the quake is. "Push" waves travel at about 5 miles a second, "shear" waves at about 3. For an approximation of the distance of a quake in this general range, multiply the interval in seconds by 7.5, which gives 3023 miles. Tables prepared for the purpose of determining the distance give 3175 miles. The first reflected "shear" wave will arrive 3 minutes and 5 seconds after the direct "shear" wave.
6. After these two kinds of waves have reached the station, a third type arrives—a "surface" wave. This type of wave travels around the earth in both directions and may pass the station a second time. In these diagrammatic drawings the core of the earth has been reduced slightly for the sake of clarity.



of the bay fills with this onrush of ocean, a great wave, like water slopping up the sides of a dish, inundates several small and hapless coastal villages. The greatest height of this seismic sea wave was 36 feet at Atami, 34 at Mera, and 30 at Ito. Such disaster has taught persons living in earthquake regions to seek the highest possible ground when the ocean suddenly retreats after the earthquake shocks have passed.

Meanwhile, with no water left in the mains to fight them, hundreds of fires were setting Tokyo ablaze. Now the still-advancing typhoon swung in to fan this new terror. Then began one of the great tragedies of the world.

In Tokyo as well as Yokohama, those not trapped in the wreckage of their homes attempted to flee as best they could along littered, semi-flooded, or fissured streets. Western Tokyo was more or less protected by the wind, but across the city many had difficulty keeping ahead of fires. Those able to, escaped momentarily into parks or other open areas. One area in densely populated Hongo ward became a haven for thousands, partly on account of its large size, partly because it seemed the fires might drive past it. Then relentlessly, just as the crowd filled it to overflowing—with 40,000 persons according to reports—, the typhoon's whirling vortex rotated along its path enough to shift winds over Tokyo from south to west. A furious 40-mile gale wheeled and bore in upon them. Soon surrounded by huge columns of smoke and flame, these helpless victims had no way to turn. As far as was ever known, from that one large area not a single soul escaped alive.

This disastrous and historic quake of September 1, 1923, left more than half the capital of Japan in utter ruin, the principal seaport, Yokohama, destroyed, and 150,000 dead.

Within a little more than 20 minutes after the first shocks, it was being recorded far and wide by the world's seismographs (pronounced like the word "size"). In 5 minutes and 32 seconds the advance waves, traveling on a nearly direct line, reached Hong Kong. In 18 minutes and 21 seconds they arrived in Calcutta. In the opposite direction they pushed to California in 11 minutes and 41 seconds. Less than three minutes later they kicked the American Museum's seismograph into action.

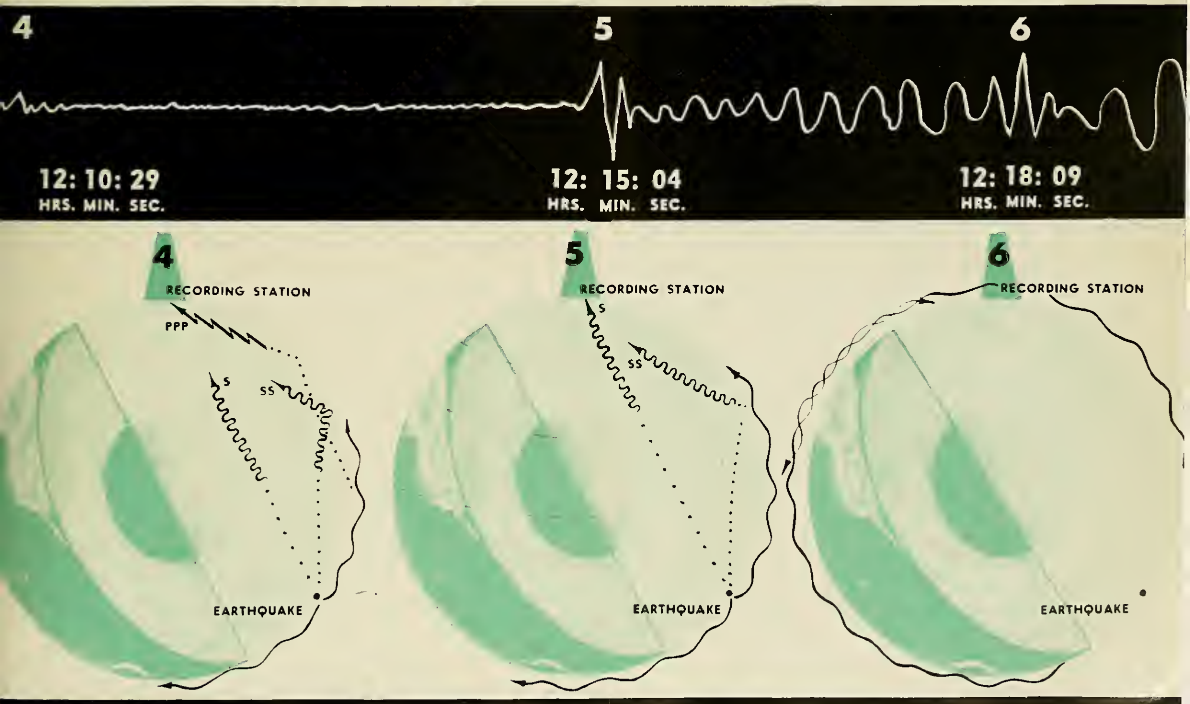
Earthquake belts

Earthquake recording instruments have also registered large quakes from Spain, Portugal, the West Indies, Mexico, Central and South America, particularly along the Pacific side. China, India, and regions under the great south seas have likewise hurled their impulses through the earth. Italy, too, has experienced some rather tough teeth-shakers. In the United States the California earthquake of 1906, followed by San Francisco's famous fire, remains the classic example, fortunately with few others to back it up.

All these earthquake regions, including Nippon, lie along very definite belts. From the time Lake Cimini engulfed a Roman city by the same name in 1450 B. C., down to recent times, these belts have given trouble.

How are earthquakes recorded and located at great distances? According to occasional remarks overheard by the writer while attending the seismograph on display at the American Museum, the instrument might seem to defy comprehension by any but the most profound minds. "What makes it run?" the visitor wants to know, or "Does this thing *make* earthquakes?" One observer, overlooking the explanatory label, recently startled the writer with, "Are you making rubber?" Another asked, "Have you ever recorded any oil under the city?"

These mistakes about the seismograph are excusable; the instrument does look complicated. But basically it is simple. You will see two large 1000-pound weights suspended like pendulums. One can swing in an east-west direction, the other north and south. A simple but delicate system of levers connects each of these weights to a needle touching a rotating ribbon of



paper. The girders supporting the weights are securely anchored in bedrock. When impulses from an earthquake jar the base of the instrument, it oscillates, whereas the heavy weights, hanging inertly, remain unaffected. This movement is amplified in the levers of the recording mechanism, and a line is drawn on the smoked surface of the recording paper. An electrical device continuously moves the paper on a drum and makes a dot beside the needle every minute and a dash every hour, so that the exact time can be determined.

The seismograph in action

Now let us watch the instrument in action. If we are lucky enough to be present when the oscillations arrive from an unknown but quite conventional quake, the first indication is a quiver on both recorders from the so-called compressional or "push" wave.

This might be compared to the first wave traveling through a steel bar struck with a hammer. Like a sound wave, it seems to pass through it extremely rapidly. The earthquake produces also another kind of wave, which produces a twisting, shattering vibration. This is called a "shear" wave. It travels only about three miles a second, whereas the "push" wave travels about five miles. Actually the velocity increases above these figures with depth. But the difference in time between the arrival of these two waves gives an indication as to the distance of the quake from the instrument.

There is no mistaking the "shear" wave when it comes poking along some five minutes and several seconds after the "push" wave. The seismograph fairly leaps into action. Other "shear" waves that have been reflected here and there along the undercurve of the earth's crust come following along for several minutes. All of these produce undulations of sharp and distinctive character. A convenient set of tables has been compiled to give the distances of quakes for various time intervals between the arrival of the first and second waves mentioned. A glance at this shows that our disturbance is centered some 2310 miles away.

A final series of "surface" waves arrive some time later (a combination of the first two), coming around Robin Hood's barn over the outer shell of the earth and leaving a weaving trail on the recording drum.

Clues as to the direction of the quake are derived from a comparison of the two separate but simultaneous records that have been obtained. One of these, it will be recalled, records east and west components of the quake, the other north and south. Both needles responded with approximately equal force, so that we know the quake must lie approximately midway between the two components. We must explore our globe along the direction suggested and, keeping in mind the definite belts, we find an active zone at the right distance and in the right direction. We can then say with some assurance, "This quake occurred off the west coast of Mexico at exactly 10:45 this morning."

But all quakes are not as easy as this, and for more certain directional checks a third component, measuring the up-and-down vibration, is useful. Italy and the Aleutian Islands are both equidistant from New York, and in a case like this it may be difficult to place the quake with only the two basic components. When an observer can check with other stations, it is usually easier to trace elusive quakes. Again, the same region may frequently send the same earthquake signature, in which case it becomes an old friend, easily recognizable.

Instruments more sensitive than the American Museum's seismograph sometimes employ a beam of light on sensitized paper, thus eliminating the frictional drag of the needle. The well-known seismological station at Fordham University, presided over by Joseph Lynch, S.J., is so equipped. Such instruments, however, cannot be exhibited before the public as functioning units in broad daylight, which is the major purpose of the Museum's seismograph. This instrument was given to the American Museum by the New York Academy of Sciences.

A large quake near New York

Occasionally some itinerant quake will show up unexpectedly far from the beaten path of quakes, but these occurrences are rare. One such notable deviation took place on November 18, 1929, when a tremendous quake, estimated as probably one of the greatest in history, occurred only 800 miles from New York City. Out on the floor of the North Atlantic it snapped twelve telegraph and telephone cables like so many pieces of thread, some of them in several places, as much as 150 miles apart. The seismic sea wave it created swept in as high as 50 feet in narrow inlets on the south shore of Newfoundland, and it shook fishing boats, freighters, liners. Here in New York the incoming oscillations were so powerful that both recording needles on the Museum's seismograph were thrown off the drums completely.

Fortunately this great quake, powerful enough to destroy large cities, was far at sea. Its passing was soon forgotten by everyone but a few seismologists and transatlantic cable companies, whose damages ran into several million dollars.

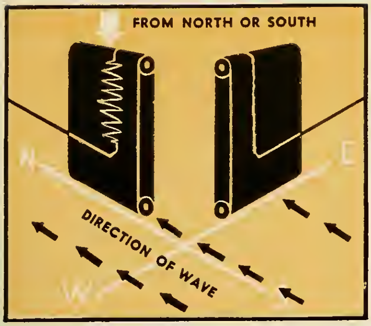
Artificial earthquakes in the form of man-made blasts are also easily picked up by seismographs set in tune with them, as are the vibrations of passing trains and traffic. It was the development of such delicate instruments that enabled oil geologists to eliminate much of the guesswork in drilling for oil. Thus the seismograph might be called the first real divining rod that ever worked. Not that it ever detected oil itself; it is far more subtle than that. It tells where or where not the underlying rocks lie in a position favorable to the accumulation of oil. Offhand it would be difficult to estimate the great benefits that have been derived from this phase of seismology alone.

The first earthquake recorder

The history of the seismograph goes back to China in 132 A. D., when the present pendulum system was utilized to record earthquakes for the first time known. The designer of the curious instrument was a mathematician and astronomer of Nan Yang Province named Tyoko. As Director of the Bureau of Almanac and History, his duties included recording the many earthquakes that then plagued China. The machine consisted of an inverted pendulum balanced so that the slightest movement would displace any one of eight small copper balls. These were set in holes equidistant in a circular frame around its crown, with which contact was established through light, radiating arms or pins. Thus the instrument was prepared not only to indicate the occurrence of an earthquake wave but its direction as well. The device was decorated with dragon heads arranged in such a way that the copper balls were balanced on their tongues; and there were squatting toads below to catch the balls in their yawning mouths if and when they fell.

One naturally wonders how sensitive such a quaint but practical instru-

Continued on page 42


FROM NORTH OR SOUTH
N
E
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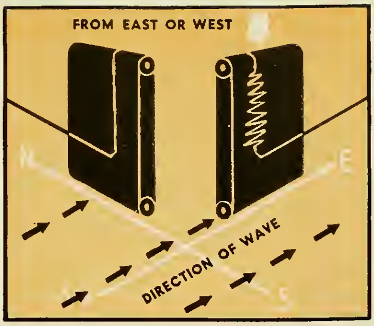
DIRECTION OF WAVE


FROM EAST OR WEST
N
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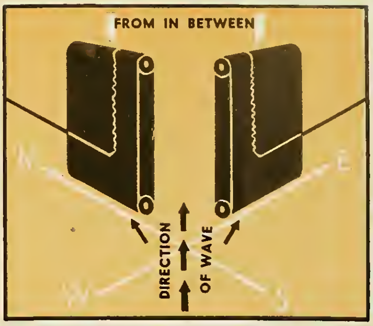
S
DIRECTION OF WAVE


FROM IN BETWEEN
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DIRECTION OF WAVE

In What Direction is the Quake?

▲ THE INSTRUMENT has two separate recorders. One reacts to waves coming from north or south, the other east and west. A quake due north or south of the station moves only the one needle

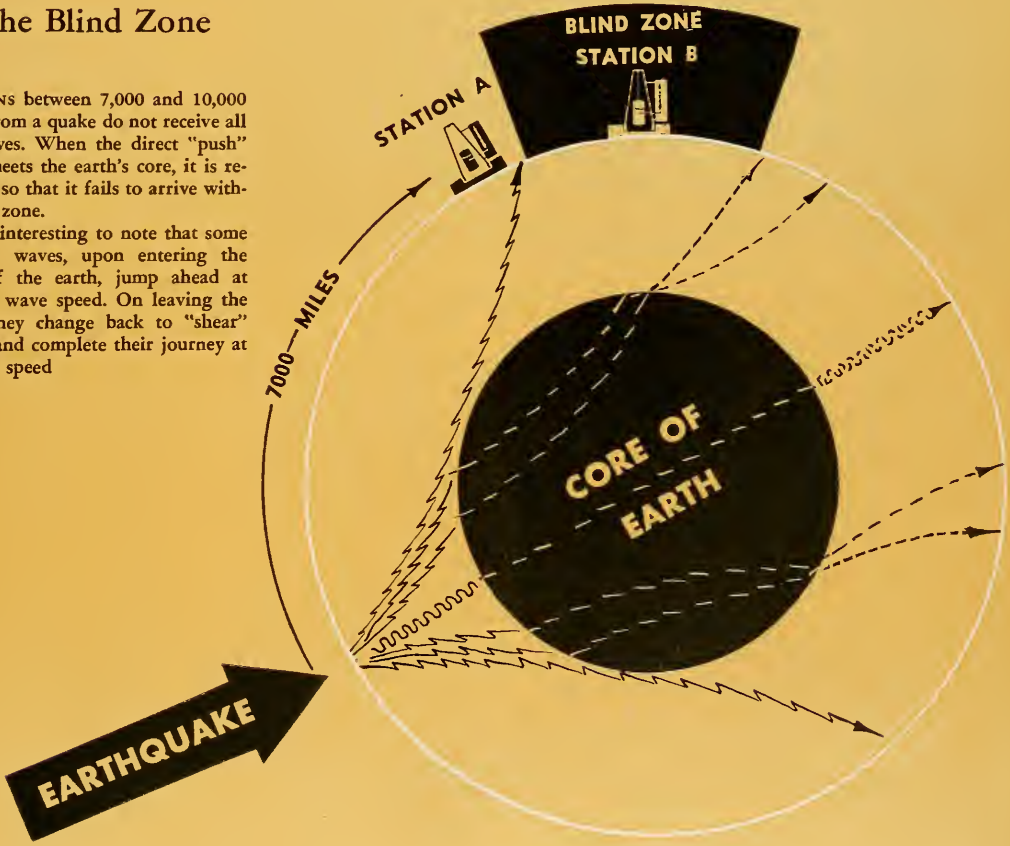
▲ IF the earthquake is from due east or west, the east-west mechanism records it. The other needle merely continues to draw an almost straight line on the smoked ribbon

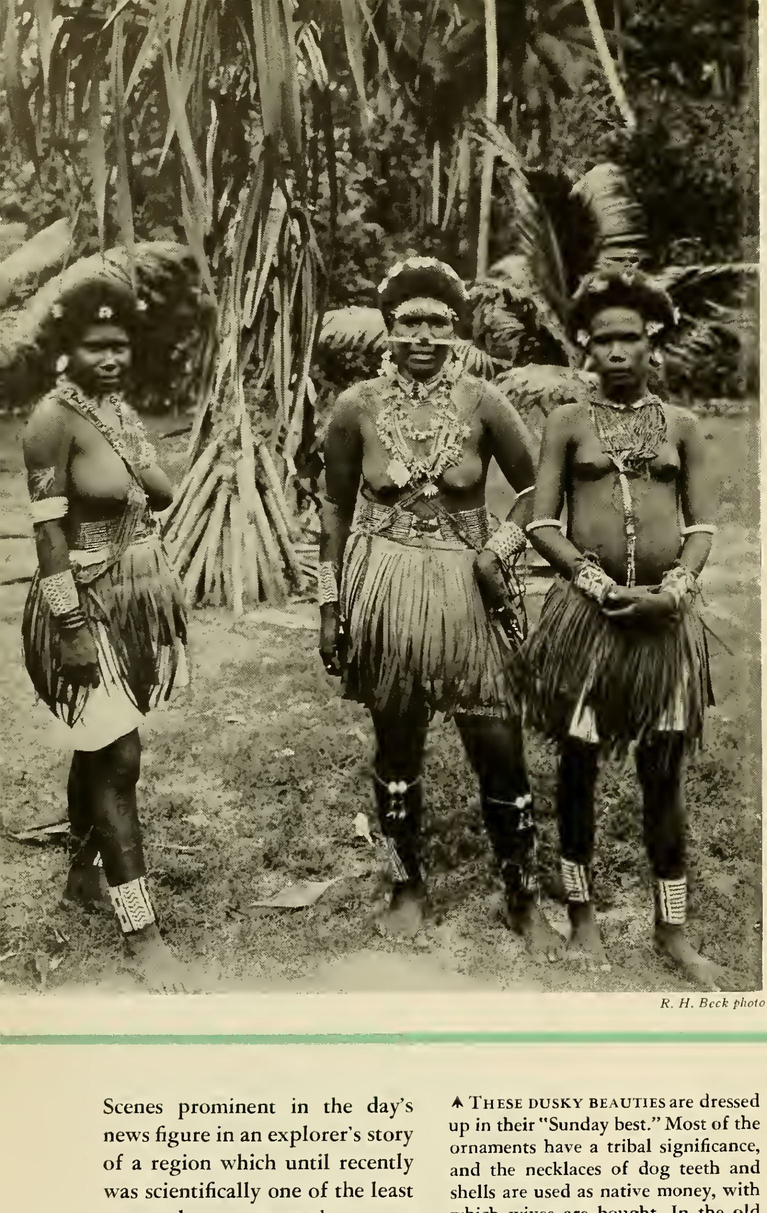
▲ IN between, both components respond, but to lesser degree. A third component for recording up-and-down vibrations helps tell whether the waves are moving with or against the arrows

The Blind Zone

STATIONS between 7,000 and 10,000 miles from a quake do not receive all the waves. When the direct "push" wave meets the earth's core, it is refracted so that it fails to arrive within this zone.

It is interesting to note that some "shear" waves, upon entering the core of the earth, jump ahead at "push" wave speed. On leaving the core, they change back to "shear" waves and complete their journey at regular speed


BLIND ZONE
STATION B
STATION A
7000—MILES
CORE OF EARTH
EARTHQUAKE



R. H. Beck photo

▲ THESE DUSKY BEAUTIES are dressed up in their "Sunday best." Most of the ornaments have a tribal significance, and the necklaces of dog teeth and shells are used as native money, with which wives are bought. In the old days even murders could be paid for with such money

A JOUR

Scenes prominent in the day's news figure in an explorer's story of a region which until recently was scientifically one of the least known on earth

By ERNST MAYR

Associate Curator of the Whitney-Rothschild Collections, American Museum of Natural History

"CAN you join Whitney South Sea Expedition in exploration of Solomon Islands?" read a cable which reached me, several weeks after it had been sent, in a little mountain village somewhere in the interior of New Guinea.

I was not at all sure at first whether I ought to be happy about this offer. Having been in New Guinea for a year and a half collecting birds and other natural history specimens, I was just about ready to go home. The enticing offer meant spending another year away from home and from my job, yet it was a golden opportunity to explore a group of islands that were less known ornithologically than any other part of the world.

The temptation was too much! I forgot all about homesickness and the impending hardships and inconveniences and cabled back a happy: "Yes."

But my trip to the Solomon Islands had a bad beginning. We left Samarai on the southeast tip of New Guinea on July 10, 1929 to sail for Faisi in the Northern Solomon Islands. Our vessel was the "France," the 76-ton schooner of the Whitney South Sea Expedition, a remarkably sturdy sailing craft with a temperamental motor which was out of commission most of the time. On the first day out of port we ran into a nasty storm which tossed us around for two days and made life on our crowded craft rather miserable.

When it finally cleared up, we were thrown into the other extreme. The wind died down completely. I remember that we heaved an empty box overboard early one morning and it had not drifted more than 50 yards away from the ship when the sun went down in the evening. Such a complete calm is a rare thing even in the tropics. The sun beat down unmercifully and, unmitigated by a breeze, it nearly fried us alive. But when we finally reached the Solomons, we were amply rewarded.

There is probably no island group in the world that surpasses the Solomon Islands for variety. Only one general statement can be made about them and that is that one cannot generalize. There are small coral islands and atolls; there are larger islands with undulating limestone hills; and there are still larger islands with high mountains. Bougainville, the largest island of the group, has an active volcano with a high plume of smoke which is well visible from the sea on clear days. Such days are not very common, of course, in the humid tropics, where the mountains are nearly always enveloped in clouds. The highest mountain on this island, Mt. Balbi, was first climbed in 1928 by an American scientist, Dr. Hannibal Hamlin, who was then leader of the Whitney South Sea Expedition.

The southern part of Bougainville, the Buin region, is the only extensive lowland in the entire Solomon Islands. Recent reports indicate that the Japa-

NEY TO THE SOLOMONS

nese have built an air port in this area. This must have been extremely laborious since the entire region is heavily wooded. In fact, these dark forests are the only place in the tropics in which I ever got completely lost.

I had left a small trail to follow the voice of a particularly rare and desirable bird. It flew from tree to tree, always keeping out of reach of my gun, and when I finally gave up the chase, I realized that I had lost my bearings. Since it was almost noon, the sun was nearly overhead and was of no help at all. Not even a compass would have helped me in getting back to the winding trail, since I had taken no bearings when I had left it. Clearly it was important not to get panicky, so the first thing I did was to sit down on a log for a quiet smoke. Then I made a clearing to which I would always be able to find my way back. From here I cut a straight trail, well marked with blazes, in what I believed to be the direction of the main path. I figured that I had chased the bird for about ten minutes, so when I failed to find the trail after about fifteen minutes, I knew I had gone in the wrong direction. I went back to the little clearing where I had found myself lost, and started off a second time, in a slightly different direction. This time I hit the main path after about ten minutes and continued my bird collecting much relieved.

Nearly all of the Solomon Islands are heavily wooded. It is only in the New Georgia group and in western Guadalcanal that grasslands are found. There has been some argument among botanists as to whether these stretches of savanna are natural or owe their existence to human activities. Where the natives cut down and burn the original forest a second growth formation springs up, which may appear like an ancient grassland if the burning is repeated regularly. However, the fact that the grasslands of Guadalcanal are the home of two endemic subspecies of birds, a finch and a button quail, indicates to me that this plant formation is older than human colonization.

The Solomons are rather wet. There are not many days on which it does not rain. In fact, they might

G. E. Petersen photo

▲ GUADALCANAL: a native hut in a clearing in the forest. A pawpaw tree can be seen in the right foreground, and young palms farther back

R. H. Beck photo

▲ A COCONUT PLANTATION west of Numanuma. Copra (dried coconut kernel) is being lightered out to a steamer, while native canoes idle near by

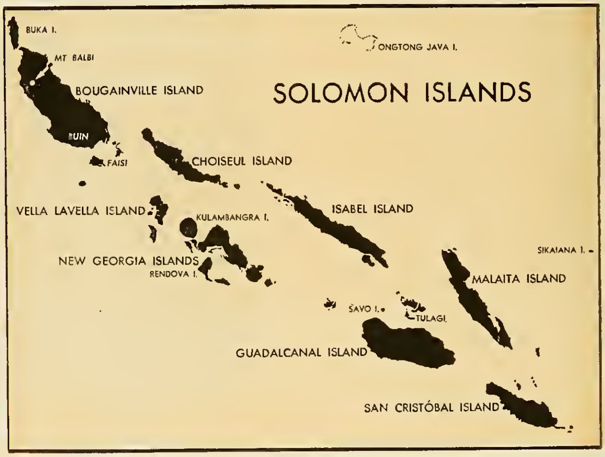
Photos by R. H. Beck

◄An avenue of lofty palms and beautifully flowering bushes adorns the approach to the residence of the District Officer on Bougainville Island

qualify for that famous description of the tropics which says that it rains every day in the dry season and all the time in the wet season! The vegetation is of tropical luxuriance, but the soil on many of the islands is not particularly good, especially on those that are recently raised coral reefs. This may be one of the reasons for the backward state of agriculture in these islands. Copra, the dried kernel of coconuts, is the main crop. Fishing for mother-of-pearl also yields some income, but most of the other tropical crops like cotton, coffee, rubber, and tea are either absent or insignificant. Another principal reason for the backwardness of agriculture is the difficulty of getting laborers. Although individual plantation owners, unless their reputation is bad, have generally been able to get sufficient workers, the big companies, whose plantations are scattered all over the islands, have always had considerable difficulties. This situation will probably not improve until contract labor is imported from places like South China, where there is much unemployment.

The New Guinea gold fever has also affected the Solomons, and there has been much prospecting in recent years. A few small "strikes" were made, but it is still too early to determine whether the Solomons have a real future as a gold country. Mendaña, who discovered the Solomons in 1567, brought home glowing reports of the fabulous riches of the isles of Solomon, but we now know that his reports were of the variety indulged in by real estate operators. He wanted to establish a colony on the island, and a good dose of optimism was more persuasive than the cold truth.

Nearly all of the islands are now under the control of the British Government—at least they were prior to the Japanese occupation—but the Solomons had a checkered history until this peaceful condition had been reached. Nobody knows what the original attitude of the natives to the white man was, because whalers and traders had visited the islands before any expeditions had an opportunity to report on really untouched natives.


SOLOMON ISLANDS
BUKA I.
MT BALBI
BOUGAINVILLE ISLAND
BUIN
FAISI
ONGTONG JAVA I.
CHOISEUL ISLAND
VELLA LAVELLA ISLAND
KULAMBANGRA I.
ISABEL ISLAND
NEW GEORGIA ISLANDS
RENDOVA I.
SIKAIANA I.
MALAITA ISLAND
SAVO I.
TULAGI
GUADALCANAL ISLAND
SAN CRISTÓBAL ISLAND

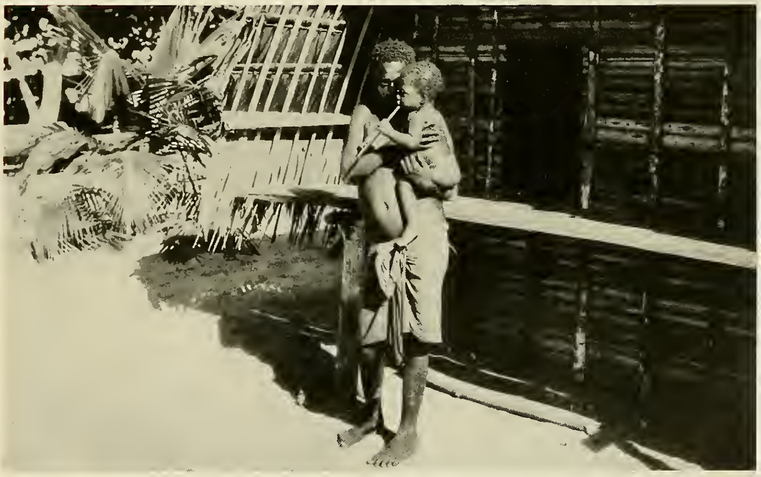
The worst chapter in the history of the Solomons was the so-called "Blackbirding" period. The sugar plantations in Queensland needed great numbers of colored laborers, and these were recruited by more or less illegal means from various islands of the western Pacific. The "recruiting" often consisted merely of luring groups of natives on board a vessel and then weighing anchor before they had a chance to escape. There was a heavy mortality among these Queensland workers, and only a few of them ever returned to their native shores. It is not surprising that the next white visitor to such a locality was greeted with spears or arrows. Blackbirding is a thing of the past, and recruiting for the plantations in the Solomon Islands is now done by peaceful means.

The natives themselves vary as much as the landscape. On Sikaiana, Ontong Java, and Rennell—three outlying islands—the inhabitants have affiliations with Micronesians and Polynesians in language, habits, and skin color. The natives of most of the other islands are properly classed as Melanesians, with dark brown skin and fuzzy hair. The inhabitants of Bougainville and particularly of Buka are even darker, almost as black as the blackest African negroes. There is no other place in the East in which the natives are as black.

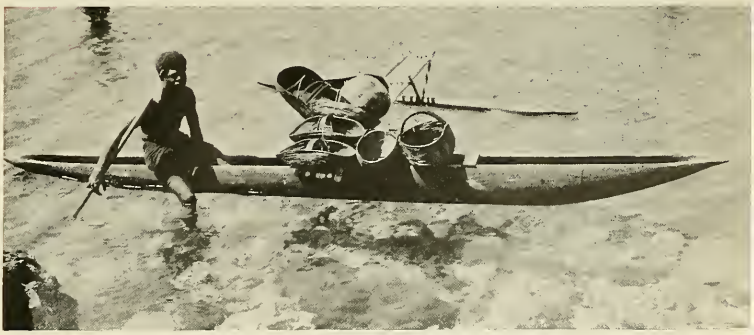
The natives of different islands vary as much in temperament and character as in physique. The old-timers among the resident whites on the Solomons assured us that the Choiseul boys (all natives in the white man's employ are called "boys") were the laziest and the San Cristóbal boys the steadiest and most dependable. The Malaita boys are potentially the best workers (most of the stevedores in Tulagi harbor were from Malaita), but they are treacherous and often disobedient.

Malaita is the only island with a prosperous native population, which is variously estimated at between 30,000 and 80,000 people. It is also the only island in the Solomons in which the population does not seem to be decreasing rapidly. The gradual extinction of the population was nowhere more apparent to us that on Choiseul. In a section where there had been prosperous villages only four or five years before our visit, the Whitney South Sea Expedition in 1929 found only a few rickety houses and the few remaining stragglers of a lost tribe.

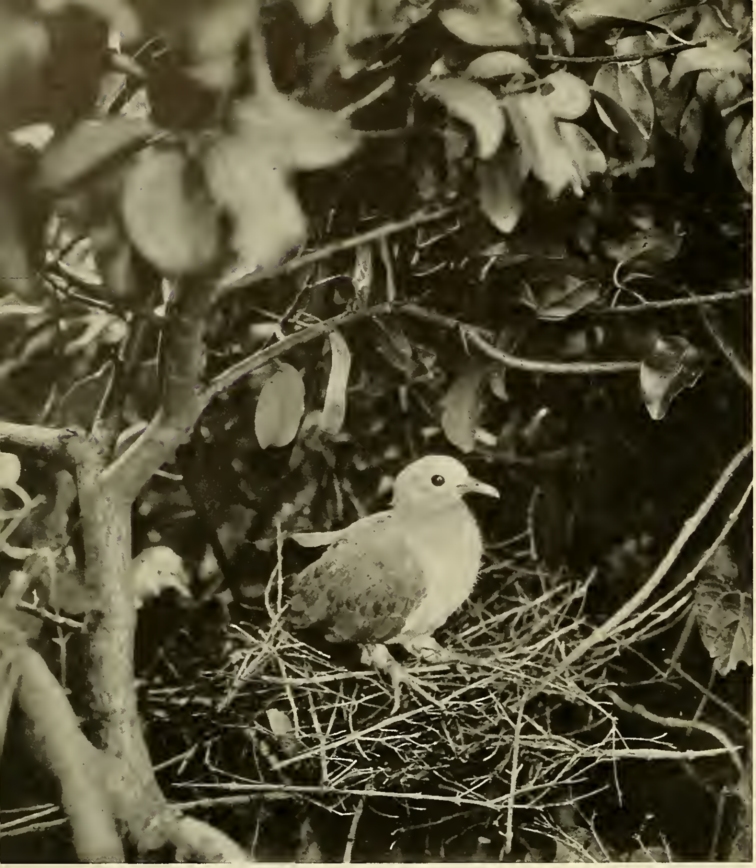
▲ THERE is no more native warfare near the coast, but the natives love to stage sham battles for the benefit of the photographer



▲ THE NATIVES are fond of children and take them wherever they go. Older girls carry their young sisters while the mothers are busy in the gardens



▲ THE NATIVE HANDICRAFTS seem to be on the decline in most places. The baskets offered to the tourist are not of very high quality

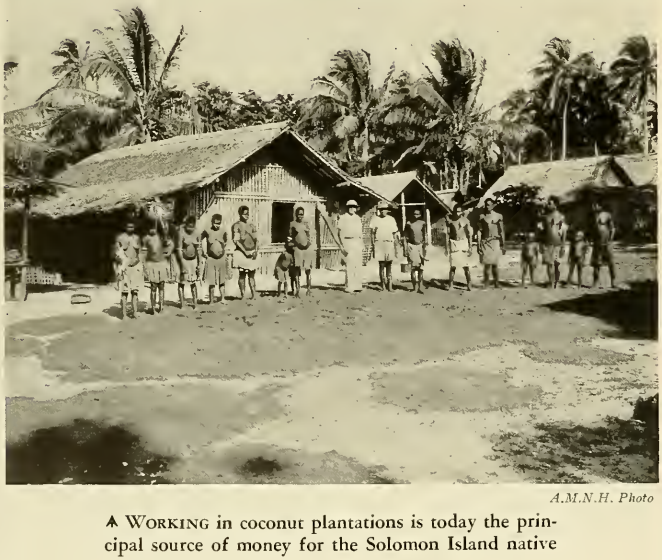


R. H. Beck photo

◄ PIGEONS are incredibly common even though they raise only one or two young in a brood. When certain nuts ripen, thousands of pigeons congregate in the nut tree groves

The reasons for such a catastrophic reduction of the population are not entirely clear. Foremost, of course, are the epidemics of the white man's diseases, against which these natives have absolutely no immunity. Mumps or measles may be an extremely serious matter for them. The white man is to blame in more ways than one. He has asked the natives to don cotton dresses (of incredible dirtiness) which induce skin diseases and probably increase the likelihood of colds. He has persuaded them to come from the mountains to the unhealthful coastal districts and has contributed in other ways to their decline. Fortunately there seems to be a turning point in the vital statistics of most tribes that have been in contact with the white man for a long time, and it is to be hoped that the population of the Solomons will become stabilized before too many tribes have disappeared.

To come into personal contact with isolated and primitive natives is an unforgettable experience. And the native, of course, finds it equally or even more exciting to see his first white man. A white man's expedition is just as big an event in a native vil-



A.M.N.H. Photo

▲ WORKING in coconut plantations is today the principal source of money for the Solomon Island native

R. H. Beck photo

lage as a circus in an American country town, bigger in fact, because it may happen only once in a lifetime. Everybody, or at least all the men and children, stand around us in groups, talking, gesticulating, smoking and chewing betel nut, which causes them to spit copiously. Their remarks are in their own language, which is unfortunate, because we would love to know what cracks they make about us and what causes them to laugh frequently and uproariously.

It is not always easy to understand the mentality of the native, and it may be even more difficult for him to understand ours. Since it is most important on an expedition to avoid friction, one frequently has to orient oneself with the native's point of view. An incident on the Whitney Expedition may illustrate this.

On our way to the interior of Malaita the only trail from our anchorage passed through the privately owned property of an elderly man, who had a herd of pigs in this area. He was extremely polite but quite adamant that we could not pass through this territory. The commotion caused by the expedition would scare his 20 pigs, which would then bolt into the territory of a neighboring tribe. He explained to us gravely that he could not afford to lose them, because his very aged father was on the verge of dying, and this would necessitate a great burial feast. The area would be ours as soon as his father had died and the pigs had been slaughtered. So an expedition that had come all the way from America had to turn back to let a savage peacefully fatten his pigs for his father's burial! As it turned out, the trail did not lead to the best mountain area anyhow, and we finally approached by a different route.

There are no wild beasts in the Solomon Islands. One can stroll through the woods without having to be afraid of being attacked by anything more ferocious than a mosquito or a land leech. There is only one extremely dangerous animal in the Solomons, but it is in the water. It is the Australian man-eating shark. I know my friend Will Beebe claims that sharks are cowards and that he was never attacked by one during any of his numerous diving exploits on the ocean floor. However, this is true only in American waters; also there is good reason to believe that the noise of the escaping air bubbles of a diving helmet may scare the sharks away. In the Solomon Islands about one dozen natives are killed by sharks every year.

These beasts are particularly ferocious when they "smell" blood in the water. I recall one horrible situation of this sort. Two fully laden canoes returned to San Cristóbal Island after a successful feast in a neighboring village. To reach the shore, the canoes had to pass a sunken reef, over which the surf occasionally broke. The first canoe passed safely, but the second canoe was caught in a breaker and capsized. All eight occupants were thrown into the water, together with a considerable quantity of fresh pig meat. The blood from this meat attracted in a very short time a large number of sharks, which began to attack the natives viciously as soon as they had gobbled up the pieces of meat. About five minutes later every one of the natives had been killed by the sharks.

The boldness of the sharks is quite amazing. I saw one native on a plantation on Bougainville Island who had washed dishes at the edge of the reef. A shark tore off half of his arm, and it was lucky for the native that he was not pulled into the water and devoured entirely. I heard a few tall stories about a giant octopus which was supposed to have attacked not only whole native canoes but even small sailing vessels; but closer interrogation revealed no creditable facts to support such stories.

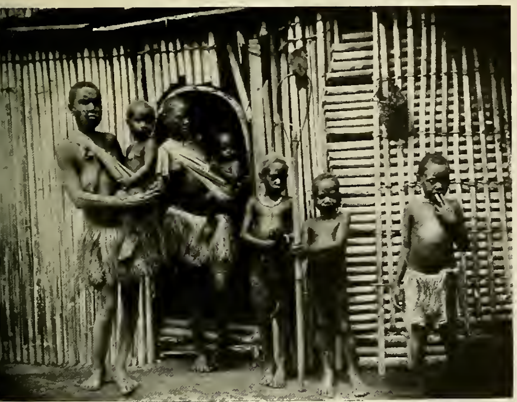
The zoological exploration of Malaita was one of the special aims of the Whitney Expedition. The natives of this island have such a terrible reputation that no ornithological expedition had ever visited it before, in fact not a single bird from there was known. Only two years prior to our visit to the island the district officer and his police escort had been ambushed by the treacherous natives and murdered to the last man. Peace had been reestablished in the meantime, and al-

"WE FOUND the Cristóbal natives articularly pleasant and reliable. he hunters proved skillful and kept s busy preparing their catch"

▼ HARD WORK probably more than the adverse climate makes the Solomon Island women appear old at an early age. A family scene on Savo Island

▼ THE DANCES are generally the climax of the great pig slaughtering festivals. Each tribe develops its own dance "figures"

R. H. Beck photo



R. H. Beck photo

R. H. Beck photos

though one of the government officials did not give us better than a 50:50 chance to come back alive from the interior, the expedition encountered no trouble and returned with a splendid collection of natural history specimens. Among the birds caught there were no fewer than three new species and fifteen new subspecies.

The mountain natives in general are good woodsmen. We employed their services as hunters whenever possible and found that they were in some respects superior to us, particularly in the collecting of the shy ground birds. Barefooted, these hunters sneak almost noiselessly through the woods, and if necessary they will sit with infinite patience for hours until a calling bird emerges from a thicket. When collecting in the mountains of San Cristóbal, we had such an excellent group of hunters that we were kept busy skinning their catch and hardly needed to leave camp.

The only son of the chief of the village at which we were camping was a good-natured boy, but he looked and acted so extremely stupid that we nicknamed him "Stupe." He was the apple of his father's eye and generally accompanied his dad to the fields or to the river to fish. Every spare moment, however, he hung around our camp and made it known by looks and words that it was his greatest ambition to go bird hunting with the "smart set" of his tribe. He seemed so unsuited for this work that we paid no attention to him. Finally one afternoon we gave him a gun that was idle in the camp and a few cartridges, partly out of pity and partly to convince him that he was useless as a hunter.

Who can describe our amazement when "Stupe" came back, a few hours later, with a couple of fine specimens including a rare black hawk—the best bird we had yet obtained. The other hunters were green with envy, but "Stupe" went hunting daily thereafter. In spite of the keen enthusiasm and diligence of the other skilled hunters, it was generally "Stupe" who brought in the best and rarest birds. I have never been able to make up my mind whether "Stupe" was merely favored by incredible luck or whether he was really quite clever in spite of his apparent stupidity.

There are no birds of paradise in the Solomon Islands, and all other animal groups are much more poorly represented than on New Guinea, but otherwise the fauna of the two areas is very much alike. Parrots and pigeons abound, and the nights are filled with the singing of cicadas and the curious noises of various tree frogs. Strangely enough not a single mountain bird was known from the islands. It is therefore not surprising that the Whitney South Sea Expedition discovered no less than thirteen species new to science. Including subspecies of lowland forms, our expedition discovered 80 new kinds of birds in the islands, surely a remarkable record for a single expedition.

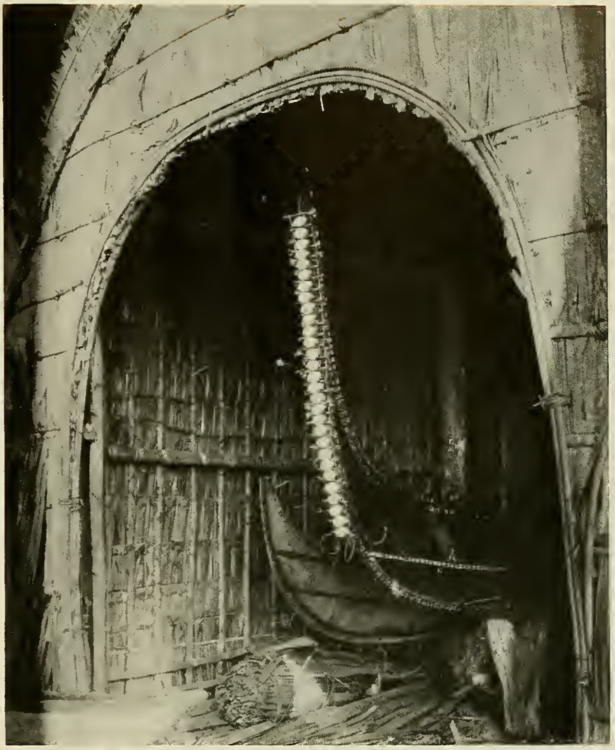
The tamest and therefore probably the best beloved bird is the "willy wagtail," a flycatcher about the size of our kingbird, which is found everywhere along the seashore and along lowland rivers. It is particularly fond of the vicinity of human habitations and generally places its nest over water. It seems to be continuously on the move, and if the bird itself is not changing its position, at least its tail will be twitching left and right. I do

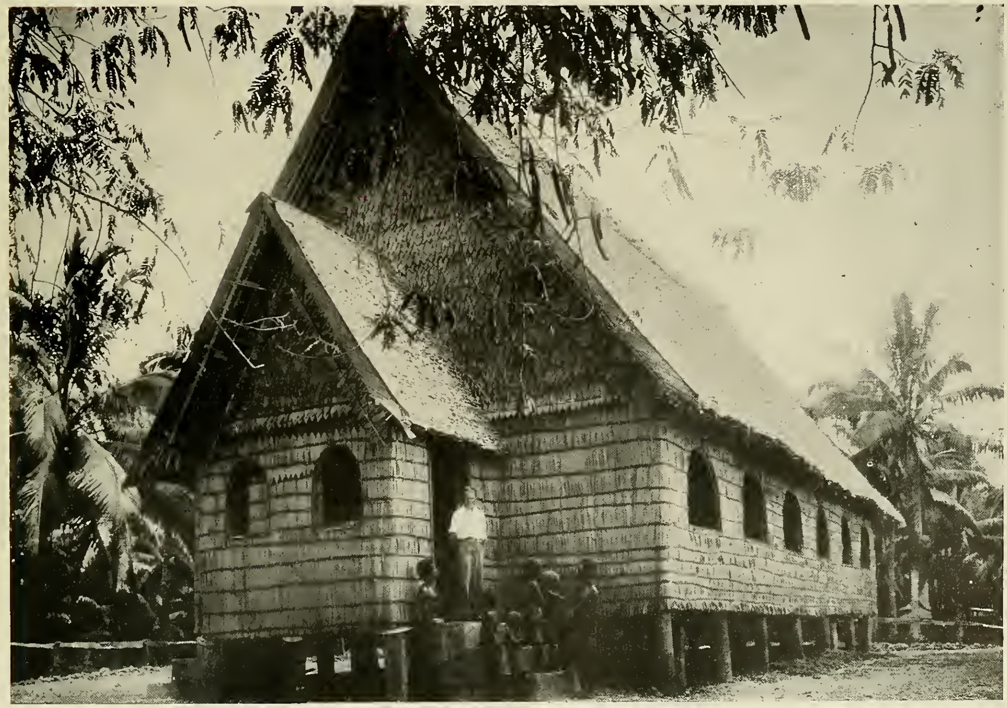
Continued on page 48

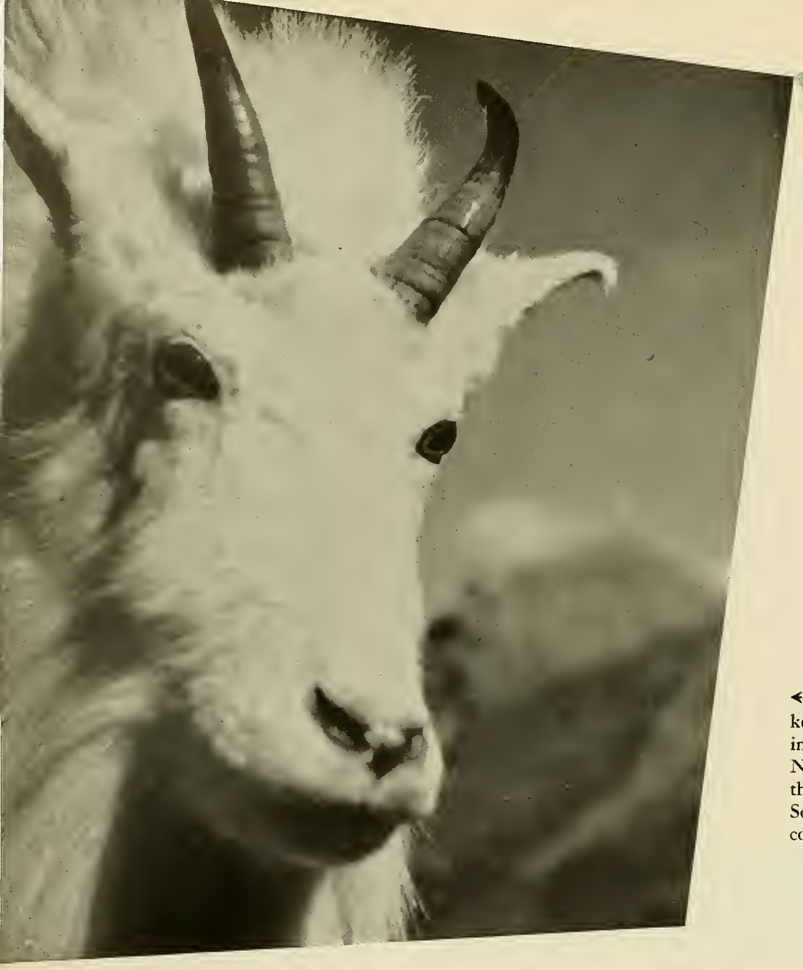
◂ THE MAGNIFICENT coconut palm is the chief wealth of the Solomon Islands. The islands are prosperous as long as the world market price of copra is high, but they are depressed when it is low

▸ THE SEAGOING CANOES of the Solomons are works of beauty and art. The canoe house has in some tribes a ceremonial importance equivalent to the church in our community

▾ MOST COASTAL and some inland tribes are Christianized. The replacement of the old religions by the new is more of a social than a spiritual revolution. These two scenes are from Vella Lavella







◂ NATURE'S original "Old Man Whiskers." Intently watching another human intruder on a near-by trail, America's No. 1 mountain climber failed to notice the photographer who was stalking him. So, here he is—a photographic trophy complete with horns and whiskers

All photographs by the author

Hunting Mountain Goats

With Miniature Camera

By HENRY P. ZUIDEMA

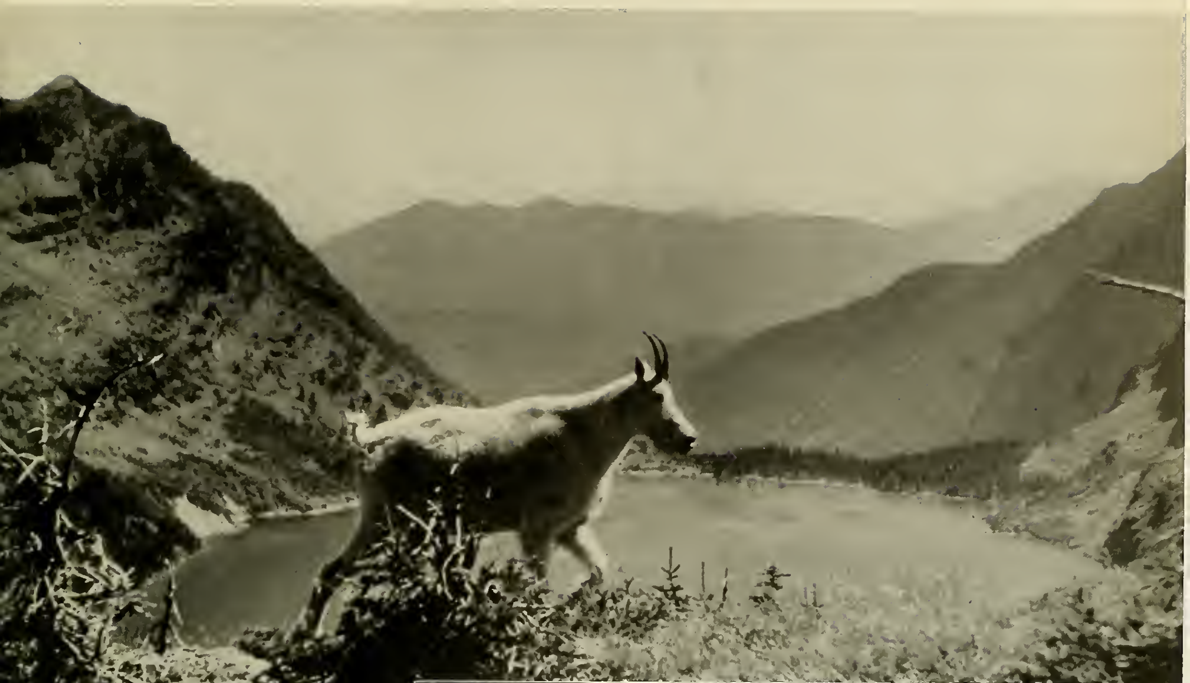
THERE are two approaches to the study of that fascinating dweller of the peaks, the mountain goat of the high ranges. One is the simple process of strolling over to the Hall of North American Mammals of the American Museum of Natural History to observe at leisure the splendid habitat group of *Oreamnos americanus*. The other method is to go directly into the rugged wilderness and climb, and climb—and climb!

When the writer was a young and inexpert mountaineer, innocent of the wiles of the mountain goat clan, he chose Goat Mountain in Glacier National Park, as a likely locality to obtain photographs of these elusive animals.

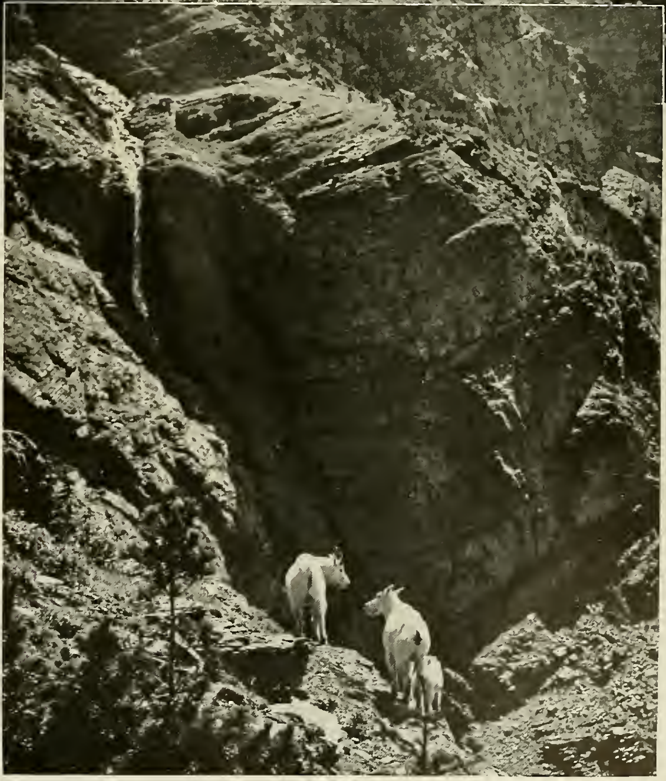
He found there were no goats on Goat Mountain, then, but discovered a fine herd up the valley, below Sexton Glacier. All day the chase went on, with the goats—young and old—always just out of camera range. Finally, late in the day, a wise old buck was stalked. But just as the young photographer approached and set up his bulky, heavy equipment for a shot in the waning light, the sun sank behind the awesome comb ridge of Matahpi Peak "and left the world to darkness and to me"—with films still unexposed.

In the intervening years, the photographer sharpened up on goat psychology and mastered the tricks involved in stalking these best climbers in the Rockies. Small, compact cameras, easily carried beside the knapsack, came to his aid, and Mr. Eastman's bright young men co-operated in supplying faster films.

Last season, sad experience and a miniature camera combined to produce the photographs here shown. The equipment consisted of a Leica 35 mm. camera, with regular Elmar 50 mm. lens, a No. 2 (orange) filter,



▲ CAUGHT momentarily between the photographer and the great cliff above Lake Ellen Wilson, Glacier National Park, this "mountain antelope" beats a strategic retreat. The photographs were all taken with a Leica camera equipped with a lens of standard 50mm. focal length



➤ THIS small alpine meadow high on the flank of Gunsight Mountain, in Glacier Park, is a favorite browsing ground for the mountain goat. Two adults and a kid stand on the brink of a great cirque wall, with an ice-fed cascade roaring down the face of the distant precipice

and a light meter. The film was Panatomic X.

Minor complications that confront both expert and novice are smoke and haze and capricious mountain light, which is usually more brilliant than the photographer surmises. Hobnailed boots and patience are important accessories.

The mountain goat is not a true goat and has no near relatives on this continent. He belongs to a group of animals known as the goat antelopes, which also includes the European chamois.

His range extends along the western mountains from northern Montana far into Alaska, and almost alone with the eagles, he frequents the high peaks and precipices, safe from attack from below. Roving carnivores sometimes attempt to stalk him but seldom surprise the wary climber.

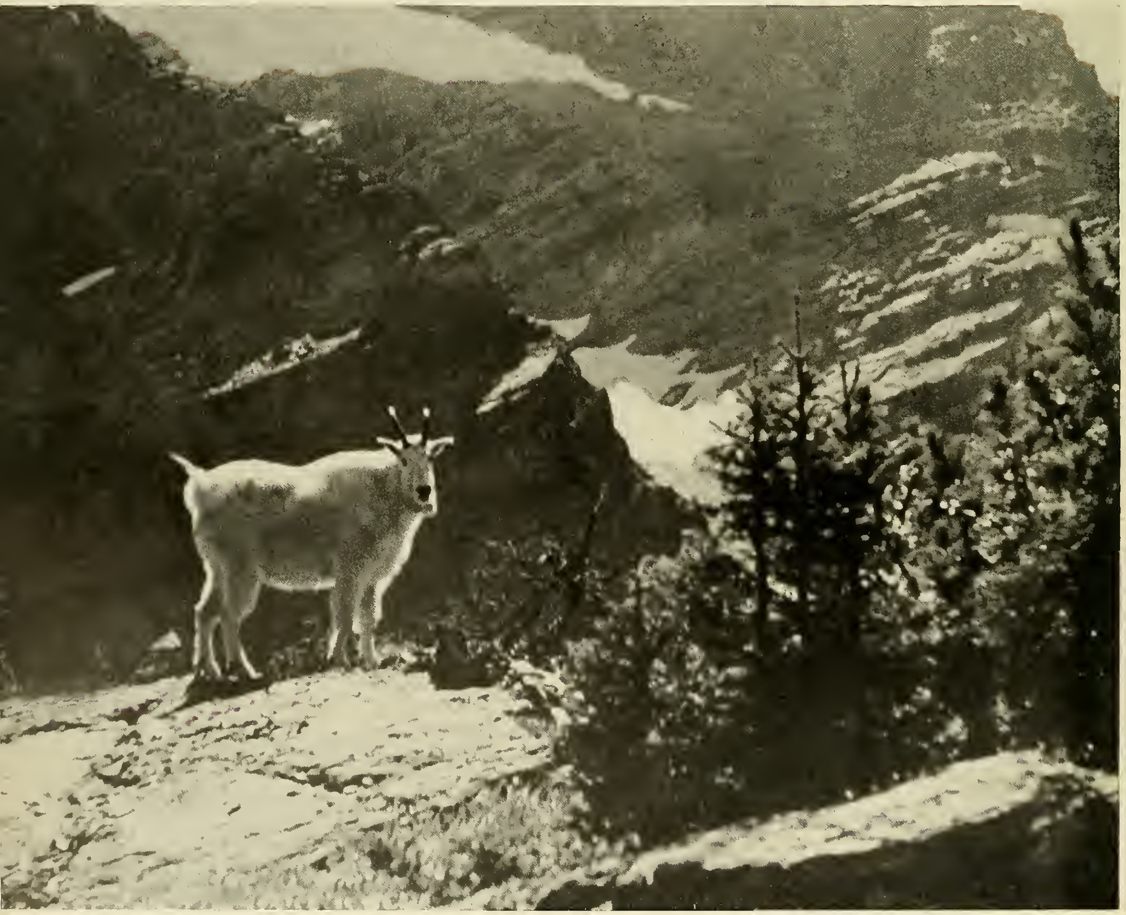
The howl of a coyote is enough to cause the "goats" to start toward the clouds, and I have observed them making their way up the perpendicular cirque wall at Iceberg Lake, in Glacier Park, until, after a sheer climb of nearly 2,000 feet above the lake, they were indistinguishable from the patches of late summer snow.

The young, usually born singly, come into the world in the spring and remain with their mothers through the following winter or until the next offspring are born. Mosses and lichens, as well as grass and tender browse, make up their food, and only the lure of salt, often placed for them at certain chalets in the national park, will bring them down from the high places, even in winter.

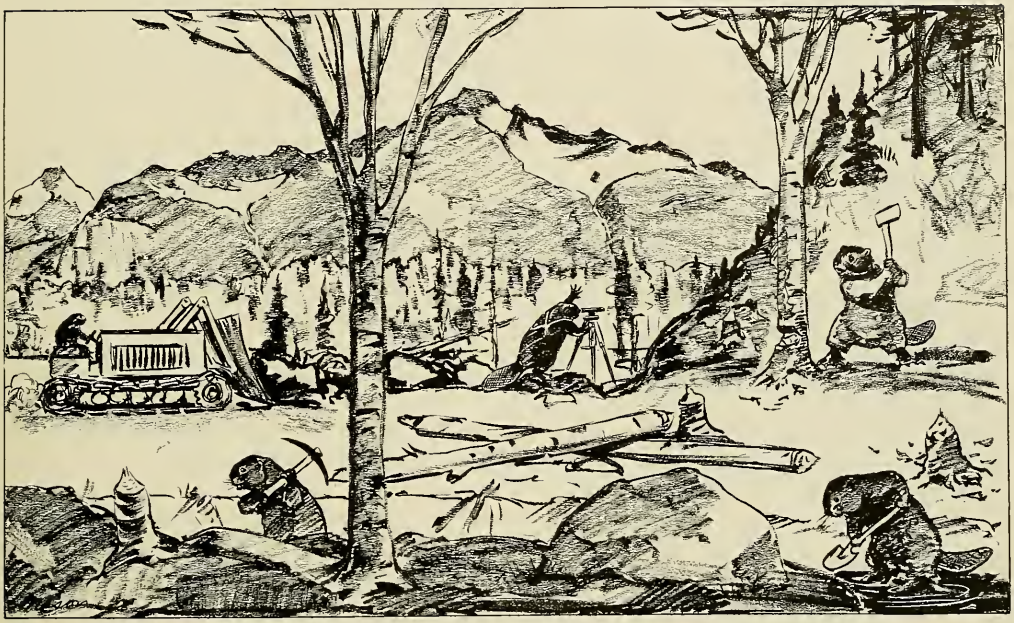
We might wish that the Rocky Mountain goat—so hardy, enterprising, and rugged an individualist of the wilds—were a representative of an old American family, but the paleontologist says "No!" The mountain antelope is a rather late arrival in America, geologically speaking, and is probably an Ice Age immigrant from Asia.

His adoption of our peaks as his home was a fortunate event for the mountain climber, nature enthusiast, and photographer. In the Hollywood sense of the word, he is an extremely "photogenic" mammal—and a fine actor, too.

"FRIEND OR FOE?" This big buck twitched his tail nervously as he studied the photographer



BEAVER ENGINEERS



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

BEAVERS partly make and control the conditions under which they live, like men do, and they have been doing it a lot longer. They do not use axes, saws, and bulldozers, of course, and it takes them a long time to fill valleys and change the courses of streams. But up to historical times the extent of their work has been greater than man's, and they have produced results comparable to such engineering feats as building airfields. Indeed, in Alaska and other mountainous regions the great meadows made by beavers offer level areas of which advantage should, and doubtless has, been taken.

In certain parts of the Rockies as much as one-tenth of the country is flat meadowland built up by the continued activities of beavers.[1] In size the meadows vary from a few hundred feet to ten or twelve square miles. That they were produced by beavers is proved by remains of the dams, the wood of which is sometimes found to be carbonizing or petrifying.

Beavers have justly acquired fame for their lumbering work, but they deserve less credit for intelligence than for industry. A beaver does not always fell a tree so that it will fall toward the pond; he makes the deepest cut on the side most easily reached, the downhill side. Now and then a beaver will cut down a tree and divide part of it into lengths that are much too heavy to handle. But generally he works with medium size aspens. The bark of these trees is the beaver's choice food, and the stripped branches and trunk sections are used in dam building.

The dams are often of great size, as much as 20 feet high, and as long as 1200 feet. Logs and branches are piled across the stream in haphazard fashion, and the chinks are filled with mud and stones. As the water rises, the beavers keep adding to their dam, until a balance is reached between the water that seeps through and what flows in. The dam is extremely resistant to floods and even to the thrust of the ice when it breaks up in the spring. Any small leak that the beavers locate is plugged.

A stream entering quiet water like a beaver pond quickly drops the gravel it may be carrying. The side of the pond where the stream enters therefore soon fills. The finer soil settles farther on in the deeper parts of the pond, and most of the ultra fine particles are filtered out by the dam. Water leaving the dam is usually crystal clear, whereas upstream it may be quite cloudy, particularly after heavy rains. A week may pass before the water in an undammed stream loses the brownish tinge due to the soil it carries.

All this sediment causes the beaver pond to fill up; and as it fills, plants grow on the new soil. Grass and pond weeds invade the edges of the pond and are soon followed by several kinds of moisture-loving bushes. Organic material is added to the soil of the pond by the plants that die, and the roots of the living ones form a dense mat that holds the soil fast, even when the pond and dam are deserted.

By the time the beavers have used up most of the food trees, the pond is pretty well filled in. The beavers then move upstream to begin a new cycle, leaving behind a meadow that gradually becomes dry land, fertile and almost flat.

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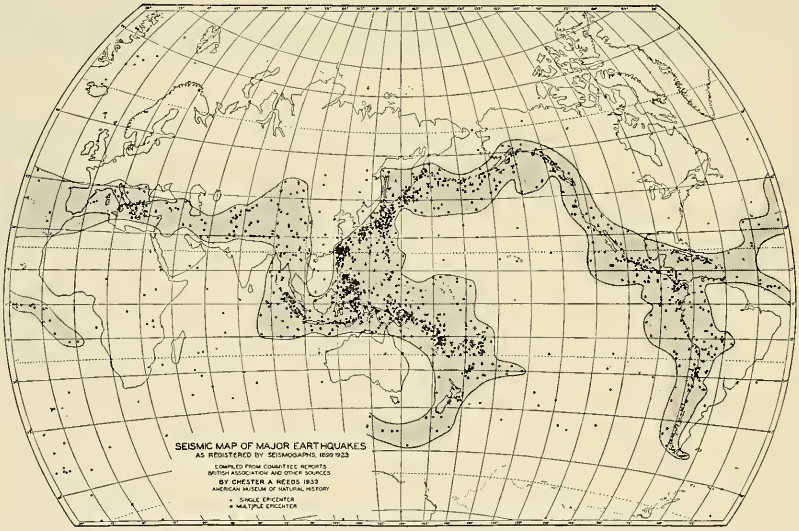
[1] Such an area was studied and reported by R. L. Ives, 1942, *Journal of Geomorphology*, V, 191-203.

Continued from page 28

ment could have been. The best answer lies in a story regarding its early history. One day a copper ball fell into a toad's mouth at a time when no tremor whatever was noticed in the vicinity. Tyoko had not expected that a *distant* quake could be recorded by the dragons and the toads—China's mystery symbols of heaven and earth. The designer of the instrument began to question its reliability. But this had actually happened, and all was cleared up some time later when news filtered in from a neighboring province that a quake had been felt the very day the little copper ball had fallen.

Thereupon Tyoko's seismoscope came into general use and seems to have been kept busy during his lifetime. But either due to a long period of seismic quiescence or other causes it was laid aside and ignominiously forgotten for the next 1800 years. It is interesting to note that an exact duplicate of this instrument was recently constructed in Japan, and until last accounts it was spitting balls into toads' mouths in the Earthquake Research Institute of the Imperial University of Tokyo.



SEISMIC MAP OF MAJOR EARTHQUAKES
AS REGISTERED BY SEISMOGAPHS, 1899-1923
COMPILED FROM COMMITTEE REPORTS
BRITISH ASSOCIATION AND OTHER SOURCES
BY CHESTER A REEDS 1933
AMERICAN MUSEUM OF NATURAL HISTORY

Much more is known of the interior of the earth than was before the invention of the seismograph. On the other hand, there are some things we have not yet learned; for example, the exact consistency of the core of the earth. Is it fluid or solid? It is different enough from the outer crust for us to define it as a distinct spherical core with a measurable radius of about 2142 miles. But just what its properties are in terms of solids and fluids remains open to some debate.

"Shadow zone"

The first real proof of a definite core to the earth is a "blind spot" that appears in earthquake recordings. Within a belt more than 7000 miles from a quake and less than 10,000, seismographs are screened from some of the impulses as an automobile is screened from radio waves when passing under a bridge. Like light beams bent in passing through a glass prism, the missing impulses have been refracted by the core, usually to appear elsewhere on the surface of the earth.

Thus the record of a typical quake 7000 miles away differs somewhat from that of a closer quake. The first "push" wave arrives as usual, having grazed the core. This is followed about four minutes later by a reflected "push" wave which has struck the underside of the earth's crust midway between the quake and the station and been "bounced." Then, 2 minutes and 18 seconds later, a "push" wave that has been reflected twice arrives.

All these have been conventional waves. However, the direct "shear" wave will not be as conspicuous as in a nearer quake, and in its place appears a new wave. This new wave started through the earth as a conventional "shear" wave, but when it encountered the core, it was refracted and converted into a "push" wave. On leaving the core, it again became a "shear" wave and arrived as such. This wave travels somewhat faster than a direct "shear" wave, because it is speeded up while passing through the core. It is known as an SKS (or shear-core-shear) wave and becomes a prominent feature of our records at around 7000 miles. At this distance it may arrive as much as a minute ahead of a straight "shear" wave, even though it has to cover a longer, deeper route. There may be still another deep core wave—the SKKS wave—, which has been reflected inside the core surface just as other waves are reflected inside the crust surface.

Beyond the shadow zone (more than 10,000 miles from the quake) regular first "push" waves that have been refracted into the core appear once more. These are followed by "push" waves that have been reflected in the usual way from the crust surface. Then two new waves appear close together, which strike, and leave the core in such a manner that one is changed to a "push" wave, the other remaining a "shear" wave. The others which follow are mostly similar to waves already discussed.

The reader may ask why "shear" waves become "push" waves within the core. Before the advent of seismology, a fluid core, more or less molten, was considered a probability, and there is evidence to support this theory.

And as has been hinted, a fluid might not be expected to carry a "shear" wave. It must be pointed out, however, that a number of separate investigators working on different quakes from records gathered over the whole world have all come to the conclusion that some "shear" wave does manage to squeak through the core—although it has been said to resemble a drowned rat upon emerging. This being the case, just what kind of a core have we? Is it a metallic body under high pressure and therefore rigid enough to give a sort of solid solution—or are we just up a tree for a better answer?

This being the Sixty-four Dollar Question of this article, upon which various seismologists have pondered without absolute agreement, you may permit the writer to pass on to something simpler, such as "surface" waves. These are never bothered by the core but come around the world unhampered, to form the happy ending to every distant earthquake record. In fact, they sometimes continue around the world until they pass a station not only once but twice, and in both directions, too. Watching the seismograph, one might say that these "surface" waves were doing a sort of Hawaiian waltz even a couple of hours after the quake has finished.

Deep-seated quakes

One of the interesting topics discussed by seismologists in recent years is deep-seated earthquakes—quakes occurring many miles below where it was supposed a slip along a crustal fracture could take place. These deep quakes were first noted when different stations disagreed on the location of a disturbance. What was wrong?

The answer, as might be supposed, came through a more detailed study of the records. It was possible to determine that some of these mysterious quakes were too deep to produce the usual surface effects. Furthermore, the actual depth was deduced from the time it took reflected waves to reach the station.

It remained difficult, however, to explain the occurrence of quakes that were sometimes as deep as 500 miles. Even at 40 miles it has been doubted that the consistency of crystalline rocks subjected to such pressures as exist there would permit the kind of slipping that is necessary for an earthquake. In a brief article we cannot dwell upon theoretical answers that have been suggested. We can only say that such quakes, regardless of their depth and other evidence to the contrary, do seem to be brought about by the same agencies that cause normal earthquakes.

The last feature of the seismograph to discuss is one which reminds the writer that there is nothing dull even in the routine of changing records. The instrument is never still. It constantly oscillates gently to movements known as microseisms. These waves may be faint or pronounced but are invariably there, unceasingly swinging the needle. Not fully understood but generally accepted to be the surf pounding against continents, they give the observer the feeling that, however infinitesimal he may be on the vast surface of this old globe as she goes rocking and reeling along her path through space, he has a delicate finger on her pulse. Today her great heart may be ticking fairly noticeably; tomorrow she may tremble and quiver like a leaf, or, at any unexpected time, we may note the swift jab of a quake. She may then be relied upon to slowly "scratch herself" with a "surface" wave, before again lapsing into a mood that fits her tempo at the moment.

The ancients used to think that quakes were caused by a monster turning over in the earth or a wrathful god venting his spleen on a people that presumably might have needed chastening. The actual cause is now usually obvious, although the forces which bring about the uplifts and displacements which actuate these jolting breaks are not clearly understood. As manifestations involving several theoretical explanations, they will undoubtedly continue to shake man and his works as long as he remains on earth.

Within a few minutes after the big 1923 earthquake that hit Tokyo so badly, the Japanese had picked up their scattered seismographs from the floor of the observatory and had them back at work recording the various aftershocks. In the years to come, we may expect earthquake research to continue to yield additional information about this planet on which we live.

Natural History

ILLUSTRATIONS

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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope
Akeley African Hall—American Museum of Natural History

YOUR NEW BOOKS

EVOLUTION BY HUXLEY ● MAMMALS OF EASTERN U. S.
GREEN EARTH ● MINERALS ● THE INVERTEBRATE EYE

EVOLUTION THE MODERN SYNTHESIS

- - - - - - - - by Julian Huxley

Harper & Brothers, $5.00

IN his first chapter Mr. Huxley reaffirms his oft stated belief in the essential validity of neo-Darwinian principles, which consist of Darwin's three primary laws with subsequent modifications arising from post-Darwinian studies in genetics. The tenth and final chapter consists of a strongly philosophical consideration of evolutionary progress together with some suggestions as to possible evolutionary future.

Chapters Two to Nine cover a voluminous but well integrated mass of data, drawn from various scientific disciplines and oriented toward the general problems of evolution. The findings of a great number of genetic studies are discussed in Chapter Three, ("Mendelism and Evolution") and Chapter Four ("Genetic Systems and Evolution"). General questions of speciation are treated under the chapter headings: "The Species Problem; Geographical Speciation," "Speciation, Ecological and Genetic," and "Speciation, Evolution, and Taxonomy." "Adaptation and Selection" and "Evolutionary Trends" are allotted separate chapters.

A work of this magnitude is not easy to evaluate. Mr. Huxley's constant willingness to interject his own particular interpretation of data gathered by other workers might arouse some adverse comment. On the other hand this very willingness adds considerable grist to his mill, with the result that the book provides a somewhat new and extremely stimulating perspective on fundamental scientific problems.

This is certainly a valuable and outstanding piece of work, and the test of time may indeed prove it to be a great contribution.

F. A. B.

THE MAMMALS OF EASTERN UNITED STATES. Vol. 2

- - - by William J. Hamilton, Jr.

Handbooks of American Natural History
edited by Albert H. Wright

The Comstock Publishing Co., $4.00

THIS book on mammals deals with some 253 species and subspecies in the eastern United States, which is intended to mean those states lying east of the Mississippi River. The subject is handled in a manner designed to make the text useful to the well-qualified student of mammalogy and to the layman who would learn more about mammals. The author has carried on field work in 21 of the 27 states included in the area, and is an active student of life histories.

Although most of the mammals inhabiting the Eastern States have been recognized by name for many years, there is still a great deal about them that is unknown. Intensive field studies over extended periods of time are providing the data to make us really acquainted with some of these creatures. Doctor Hamilton has carried on some of these projects, and his book will be a useful reference for students and stimulation for others who may wish to fill in gaps in our knowledge.

There exists a fair number of books written about the mammals of a state or a restricted area like the Adirondacks. Some of these are classic accounts. But in general the Eastern States, because they were studied first and presumed to be better known, have not received the attention in literature given to the Western States, where forms new to science are still being discovered. There are today great opportunities for discoveries in data covering life histories in all the Eastern States. It is high time we learned more about these mammals, and Hamilton's book is a fine start in the proper direction.

This volume is well illustrated with both drawings and photographs. Geographic distribution is shown by numerous good maps, and there is a well selected bibliography at the close of the book.

H. E. ANTHONY.

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THE MAMMALS OF COLORADO

- - - - - - by Edward R. Warren

Second (revised) Edition

Univ. of Oklahoma Press, $4.00

THE *Mammals of Colorado* appeared in the first edition in 1910 and has been a very useful book over the years. The present volume is a second and revised edition which had reached the first proof stage when the author was stricken by a fatal illness. The final stages of publication were under the supervision of the author's widow.

The book is a well-planned and prepared report upon the mammals of the State, written to give data for specialist and layman alike. The treatment follows the current systematic classification and the characters of each subdivision or category are given in a brief synopsis. Then follows the section given over to distribution, life history, and other items of general interest. Common names and Latin names are given for each form.

The accounts of life histories are drawn from various sources, a good deal of it from the author's personal field experience. While some of the text is identical with that of the first edition, there is much new material and the book has a greater content.

It is well illustrated, has an extensive bibliography, directions for making study specimens, a section on life zones, a short glossary, and an index.

The Mammals of Colorado is a good book to own for reference as well as for the interest one can find in reading the nondescriptive text. It has its greatest usefulness, of course, for anyone most concerned with the fauna of Colorado, but a great deal of the information applies with equal force to the mammals of the West or to North American mammals in general.

H. E. ANTHONY.

THE GREEN EARTH

An Introduction to Botany

- - - by Harold William Rickett

The Jacques Cattell Press, $3.50

MR. RICKETT served for nineteen years as a professor of botany at the University of Wisconsin, the University of Missouri, and Reed College in Oregon. As coauthor of a widely used textbook in botany, editor of several botanical periodicals, and author of many scientific publications in his field, he has contributed greatly to the more technical literature on the subject. In *The Green Earth* Mr. Rickett reveals decided talent as a writer for nonscientific readers. He has popularized his subject in the highest sense of the word. The basic principles of botany are so clearly expounded and so aptly developed that the reader moves steadily through the pages without any feeling of effort and with the solid satisfaction of knowledge gained.

The titles of the first nine chapters indicate in a general way the contents of the book: "Of the Green Color of Leaves and What Comes Of It," "Of the Anatomy of Leaves," "Of the Architecture of Plants," "Of the Growth of Plants," "Of the Purposes of Plants," "Of Flowers and Their Fruits," "Of the Likeness of Peas in a Pod," "Of Names, Of Fern and Moss." Chapter X deals with the evolutionary history of plants and touches upon the topic of speciation. The eleventh and concluding chapter introduces the reader to problems of disease and parasitism in plants.

The reviewer enjoyed Mr. Rickett's book tremendously and recommends it unhesitatingly to those who wish to make an acquaintance with, or to review the fascinating subject of botany.

F. A. B.

PLANTS WE EAT AND WEAR

- - - - - - - - - by H. E. Jaques

Published by the Author
709 N. Main, Mt. Pleasant, Iowa
Brochure $1.50; Cloth $2.50

THE author is a professor of biology in Iowa Wesleyan College, and this little volume is another of his attractive and useful "Pictured-Key Nature Series." It was a happy thought to bring the plants we eat and the plants we wear together in a little book. The only place, known to this reviewer, where all this information can be secured is in a work on horticulture consisting of several large tomes. Our present little book has a distinct advantage in that nearly every species is illustrated with good clear line-drawings.

Here we find all of the surprising array of vegetables of the cabbage family arranged, described, and individually illustrated: cabbage, Chinese cabbage, kohlrabi, turnip, rutabaga, cauliflower, broccoli, mustard, Brussels sprouts, kale, etc. Included here we find the cinnamon-tree from Ceylon, maté from South America, the mangosteen from Malaya, the cherimoya from Ecuador and Peru, the litchinut from China, the baobab from Africa, and many other plants that we like to know more about.

The plants we eat—figured and described, range from agar-agar and Irish moss of the algae, through Iceland moss of the lichens, yeast, and a few mushrooms of the fungi, to the flowering plants—a fascinating array. Among the plants we wear there are included not only fiber plants, such as species of cotton, flax, hemp, and jute, but also those that furnish dyes and perfumes, as well as a number of rubber trees.

The book has a simple analytical key running through it, which if followed would enable one to identify practically all of the plants that furnish us food or clothing. The drawings are so clear, however, that it is comparatively easy to locate a plant by the unorthodox method of leafing through the book and looking at the pictures.

CLYDE FISHER.

GETTING THERE: THE PSYCHOMOTIVATEASE

A Textbook in Zoology in the form of a Poem with Pen and Ink Sketches

- - - - - - - by R. M. Yergason

Privately printed but "dispensed" by Mrs. A. R. C. Yergason, 89 Van Buren Avenue, West Hartford, Connecticut, $1.00

AN impartial student of the arts and sciences might well wonder why the zoology of the textbooks has usually been left to wander in its own desert of technicalities, without benefit of music, verse, or jingle. Bright exceptions to the rule were the opuscule on *How to Tell the Birds from the Flowers* by R. W. Wood, now almost a classic, and *How to Tell Your Friends from the Apes* by Will Cuppy.

With the praiseworthy motive of deglooming zoology, the author, a physician and surgeon, who evidently knows the value of brightening up his patients, tells us that

This is to stimulate the thought
How various forms of life cavort,
Hoping that you may hereby be
Awakening to activity.

And his opening verse gives the theme:

One who surveys the active features
Of all the various living creatures
Becomes imbued with great devotion
Toward studying forms of locomotion.

After this auspicious start the verse meanders pleasantly along the branching

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Summer, 1943.

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Science for the Seven Million

This program is now under the sponsorship of NATURAL HISTORY Magazine and is broadcast directly from the Museum. All members wishing to attend the broadcast are cordially invited to do so.

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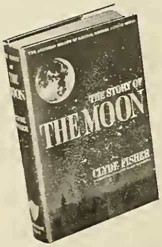

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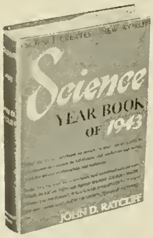

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by John D. Ratcliff

Here are the thrilling stories of scientific discovery and advance that have appeared in leading magazines during the past year—written by such well-known personalities as Quentin Reynolds, Claud R. Wickard, and many others. 28 separate articles cover such topics as sulfa drugs; a youth-retaining vitamin; brain waves; torpedo planes; new synthetic varieties of dogs; etc. This is the second in the series of Mr. Ratcliff's Science Year Books. "Mr. Ratcliff is a human centrifugal separator. A thousand and more popular articles on recent scientific developments have poured into his brain, like so much whole milk. Out came the cream in the form of his SCIENCE YEAR BOOK." Waldemar Kaempffert, author of *Science Today and Tomorrow.* $2.50.

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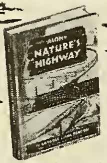

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CHIMPANZEES
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By Robert M. Yerkes

For twenty-five years Dr. Yerkes and his staff have conducted pioneer studies of chimpanzees. In this book he sums up his knowledge of the most adaptable and quick witted of the great apes.

The reader will learn from this volume something not only about chimpanzees but about himself as well. For this ape resembles his human betters in more ways than one, and while he is an experimental subject of tremendous resources in his own right, under Dr. Yerkes' careful analysis he becomes something even more interesting.

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highroads and bypaths of animal locomotion, and a reviewer has constantly to resist the temptation to cite such neat ones as this:

The Flagellates just whip the tail,
And up and down, around they sail,
Which way to go it just depends,
For tails are on two or three ends.

In good time we arrive at the Primates:

Our insectivorous Grandpa Shrew
A life in trees resorted to,
Late generations after him
Swung by the arms from limb to limb.

From thence the ascent to the stratosphere and the descent in Doctor Beebe's bathysphere follow in due course.

After these pleasant relaxations, the book closes with a sober and well selected list of references.

Notwithstanding the lilt of the verses and the neatness of the drawings, the collection does not really tell a connected story of the various methods of locomotion practiced by the creatures figured, chiefly because fundamental principles are rather lost sight of amid the spectacular facts. Nevertheless this little book may be welcome as a source book for texts or slogans by biology teachers with a sense of humor.

W. K. G.

THE VERTEBRATE EYE AND ITS ADAPTIVE RADIATION

- - - - - - by Gordon Lynn Walls

Cranbrook Institute of Science, $6.00

THIS comprehensive treatise consists of three sections: anatomical-physiological, ecological, and zoological. The first section deals with the structure and development of the human eye and the mechanism of the visual process, including dark adaptation and color vision; the Young-Helmholtz trichromatic theory of color vision is supported.

The ecological part treats of arhythmic (24-hour), diurnal, nocturnal, and crepuscular habits, and the visual adaptations and mechanisms related to these habits. Topics given detailed discussion include retinal pigments and their migrations, pupillary shapes and control, color filters, relation of rods and cones to varied light conditions, various types of tapeta in animals, and the mechanisms of accommodation in the various vertebrate groups. Binocular and monocular vision receive adequate discussion. There is a large section on vision in various media—under water, in air, and in forms with amphibious vision. The question of color, vision among vertebrates is lengthily discussed with reports of experimental work.

The zoological section considers the structure of the eye and the characters of the retina throughout the vertebrate groups and should prove of great value to comparative anatomists.

There is scarcely any question which might arise about the eye and vision in the mind of laymen, naturalist, or zoologist which is not considered. The result, however, is a somewhat unfortunate juxtaposition of highly scientific and popularized material. The reviewer feels that the amateur naturalist, at whom among others the book is aimed, would be unable to understand large sections of it. There is a dearth of really original figures, and the author is too apt to invent logical explanations for everything. However, these minor faults do not detract from the great value of the work as a reference book usable in many fields.

LIBBIE H. HYMAN.

MINERALS AND ROCKS

- - - - - - - - - by R. D. George

D. Appleton-Century Company, $6.00

AS Professor George remarks in his preface, few books survey the entire field of earth material, though many are available on such distinct topics as minerals, ore formation, rock formation, and rocks. In this one volume of nearly 600 pages he has made a new kind of compilation of this information, aiming it alike at the college student and the advanced amateur.

This is the only extensive recent work which has the minerals classified according to their principal or valuable element, in place of the widely used acid-salt sequence which commenced long before J. D. Dana's work. After a discussion, with numerous illustrations of the ore forming processes and the origin of minerals, we are introduced to the many minerals under such headings as "Iron, steel and alloy metals," "Major non-ferrous industrial metals," "Precious and semi-precious metals," and so on. A section on the determination of minerals precedes the latter third of the book, which takes up rocks, and this treatment not only tells about all the rock types but their manner of formation. A classification by uses precedes a useful glossary of terms that may be unfamiliar to the nonstudent reader.

Despite its ambitious claims, it is a little disappointing in two scores. The many illustrations are not as good as we should expect and the crystal drawings are often crude. Its rather forbidding atmosphere is likely to discourage the amateur, and few professors will adopt it for their college courses since few will care to follow this sequence. Though a fine and very concentrated introduction to the entire rock and mineral field, it is probably too strong a dose for the amateur and general student, yet too broad for the specialist who will prefer rock or mineral books with fuller details about their especial interests.

F. H. POUGH.

FAMILY TREASURES

- - - - - - by David D. Whitney

The Jacques Cattell Press, $3.50

THE outstanding aspect of this popular book on heredity is the liberal use of photographs to illustrate various physical, mental, and emotional traits that seem to "run in families."

These pictures are quite useful in demonstrating familial physical resemblances as discussed in the first ten chapters, which deal with the following topics: The Family; The Individual; The Hair; The Eyes; The Mouth, Lips, Teeth, and Tongue; The Ears; The Nose, Cheeks, Chin, and Jaws; The Hands; The Feet; and The Body.

In Chapter 11, which treats "Temperament and Special Abilities," the pictures are somewhat less effective since there may be some question as to whether such traits as "artistic temperament," "musical ability," "superior ability of literary expression," "religious zeal," "natural grace and charm of manners," etc., are revealed by photographs.

The book includes a highly simplified explanation of Mendelian heredity and a brief discussion of polygenic traits.

Some readers may feel that Professor Whitney has not sufficiently emphasized the occurrence of familial resemblances produced as a result of social relationships. The existence of nongenetic transmission of some traits does, however, receive treatment and the discriminating reader may be expected to grasp the implied distinction.

F. A. B.

SLEEPING ISLAND

- - - - - - - - - by P. G. Downes

Coward McCann, $3.50

THIS is the story of a man's travels by canoe over on uncharted route from Lake Winnipeg in Manitoba north to Nuelton Lake in the Barren Lands northwest of Churchill. The Barren Lands is the name for the vast area above the 60th parallel, crossing in a great arc from Hudson Bay northwest to the Mackenzie River. It is the north in which the endless spruce forest at last surrenders to the gaunt, open, wind-swept land of the treeless tundra, where the swarms of black flies and mosquitoes tax the white man's endurance to the limit.

In the spring of 1939 Downes and his trapper friend John, drawn by the call of the north, made their way up the Cochrane River and then across a chain of lakes to Nuelton Lake of the Sleeping Island. The narrative relates their experiences in poling and shooting the treacherous rapids, packing canoe and heavy loads over portages, and following a faint trail that could hopelessly lose them in a vast labyrinth of lakes and rivers. Here they met the wandering tribes of Chipewyan Indians and their traditional enemies, the Inland Eskimos, that still live as they have from time immemorial—free hunters, proud remnants of a people that are rapidly disappearing. I enjoyed reading this book, and the descriptions brought to mind the hair-raising experiences I had had on the Nahanni River at the Rapids of the Drowned and Hell's Gate, where the reckless Indians drove our canoe through the surging green water and white-capped rapids, and laughed at the dangers where so many of their countrymen had perished.

Sleeping Island is written in simple descriptive language, illustrated with 32 photographs taken by the author, and contains 296 pages of text. Mr. Downes is a native of Connecticut, a graduate of Kent School and Harvard, and he is at the present time engaged in war work.

GEORGE G. GOODWIN.

SEA OTTERS

Continued from page 23

sea otter can live indefinitely in fresh water, one pen has been built in a fresh-water lake near by. Over a century ago Russian fur hunters reported seeing sea otters in inland lakes of the Aleutians, but it is not known whether this was their natural habitat or whether they were visiting there. The animals that we saw in the fresh-water pen appeared to be every bit as active and healthy as those in the salt-water pens.

The scientist in charge of this Experimental Station is assigned to his post for three years. On this bleak, treeless, rocky island, with no other white man for company, it was indeed edifying to find this gentleman so content and gratified with the accomplishment of his task. He was proud of his work and only too happy to show us all he could; however, owing to the language difficulty, it was hard to obtain much information from him.

At the enclosures the scientist threw a fish to one of the sea otters. The otter deftly caught it in its "hands." Rolling over on its back, it took the head of the fish in one "hand," the tail in the other, and commenced to eat it at leisure in a very dignified manner. Having finished, the sea otter carefully brushed the remnants of the meal off its chest; then, dipping its hands in the water, the animal rubbed them together just as a person does when washing with soap and water. This finished, the creature proceeded to wash its face carefully, even going behind its ears like any human being. Finally, to complete the toilet, the whiskers were brushed off sideways.

A short time before we arrived one sea otter was having great difficulty in giving birth to her pup. Usually only one pup is born at a time, birth taking place at any time throughout the year. In order to save the life of this mother sea otter, the biologist had to operate. He was successful in saving the life of the mother, but he was chagrined to lose the pup. Later in his laboratory he proudly showed us his first attempt at taxidermy—the sea otter pup which he had been unable to save.

This experiment at Gladskuvskaya is obviously a most worth-while project and is one that may, in a few years' time, succeed in obtaining all the necessary information relative to this valuable animal. This information in turn may be the forerunner of a prosperous fur industry for the Russians. By using a similar conservation program to that used by the Russians with the seal herds at Syevexnoe, on Bering Island, it would seem most likely that in the future the sea otter herds will be maintained and at the same time a certain number taken yearly for their pelts.

Prior to the war, plans were afoot to place men on one of the Aleutian Islands which is the habitat of the sea otter. While studying the animals, these men would also be able to protect them from Japanese poachers, for it is very unlikely that the Japanese would attempt to land on one of our occupied islands.

The best laid plans of mice and men go astray in war time. It is to be hoped that after the war is over we will be able to follow the Russians in a similar program, which will lead to an increase in the number of sea otters and give us more knowledge of these interesting and valuable animals.

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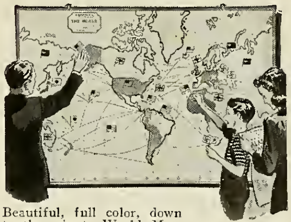

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SOLOMON ISLANDS

Continued from page 36

not know whether it ever sleeps, since I have often heard it singing in the middle of the night.

In the woods the most conspicuous bird is perhaps the whistler *(Pachycephala pectoralis),* whose ringing song is easily remembered. The male is of a beautiful yolk yellow underneath with a broad black band across the breast, while the upper parts are olive. The female is of a duller color, more or less grayish or olive white. This species, incidentally, presents one of the most spectacular cases of evolution, one that would have delighted Darwin, if he had known it.

The whistler is different on every one of the major islands of the group, breaking up into fourteen different subspecies. Some of these are so different that they might equally well be called separate species. On Malaita, for example, the black breastband is missing; on Nissan the throat is white; on Rendova the wing is black instead of olive; on Vella Lavella the entire upper parts are black; and on Rennell Island the male is dull colored and indistinguishable from the female. Similarly striking cases of evolution are presented by many other species of Solomon Island birds.

Solomon Island birds are not only fascinating to the evolutionist, but also to the student of habits and behavior. Much has been written about the megapodes, the "incubator birds," which lay their eggs in heaps of dead leaves they scratch together on the forest floor. The fermenting leaves generate sufficient heat to insure the successful hatching of the young. On Savo Island and in other volcanic places the birds lay their eggs in the hot ashes, evidently picking a spot with just the right temperature. What puzzles me most is that not infrequently we found the eggs merely buried in the loose soil between the roots of some forest giant. These eggs seemed to be developing normally even though the temperature of the soil was, if anything, lower than that of the air (not higher than 82°).

And then there is the riddle of Microgoura. In January, 1904, Albert Meek, Lord Rothschild's enterprising bird collector, landed on the eastern end of Choiseul Island and in a few days collected seven specimens of a strange crested ground pigeon, a bird which was entirely different from any other pigeon in the whole world. To get additional specimens of this fabulous bird and to learn something of its habits was one of the tasks that had been especially impressed upon us by the authorities of the American Museum. We went at it systematically. We combed the island from one end to the other. We climbed the highest mountain and, splitting up into several parties each with its own camp, competed for success in the undertaking. But alas, after three months of the most diligent search we had to admit defeat. The older natives knew the bird well, but they were unanimous in believing that it had disappeared completely. Why it should have become extinct is a mystery, since Choiseul Island certainly has not changed very much since Meek's days. Incidentally, the Museum's desire for Microgoura was finally satisfied. Five of Meek's specimens came into our possession, along with many other treasures, when the priceless Rothschild Collection was given to the American Museum.

For the ornithologist each island has its special problems. There is a peculiar kingfisher on Bougainville Island (with a yellow ochre bill) whose nearest relative seems to be in the Philippines. The Whitney Expedition discovered a very distinct race of it on Guadalcanal. Then there is the mountain warbler of Kulambangra Island, an endemic genus *(Mochthopoeus),* which seems to have no close relatives. San Cristóbal, the easternmost of the larger islands, has a fauna that is peculiarly different. It lacks the crow, the cockatoo, and one or two other species found throughout the rest of the Solomons, but it is the home of some birds that are otherwise peculiar to the New Hebrides or some other group of faraway islands. Dr. Ernst Hartert, the late director of the Rothschild Museum, assured me once that after studying the birds of the world for over 40 years, he had come to the conclusion that the Solomon Islands were the most interesting group of islands in the entire world, ranking ahead even of the Galápagos and Hawaiian Islands.

The nine months during which I had the fortune to be a member of the Whitney Expedition passed like so many weeks. And, when I finally left the islands, I knew that I had made the right decision in joining the expedition. Thirteen years have passed since then, and what a change has come over the Solomon Islands! It seems quite incongruous to pictur them as a scene of bitter fighting, wit cruisers and airplane carriers rulin the seas which used to be the domai of trading schooners and native canoes To be sure the aura of the Solomon was never as idyllic as that of Tahiti the Marquesas, or other of the Poly-nesian Islands. There was alway something virile about the Solomons, for a tradition of blackbirding and head-hunting is not easily overcome. But even without the typical South Sea Island romance, the Solomons are, at least to a naturalist, a paradise. I know of a few still unexplored places, and it is a secret ambition of mine to return there some day and collect a few of the birds that I know are still awaiting discovery.

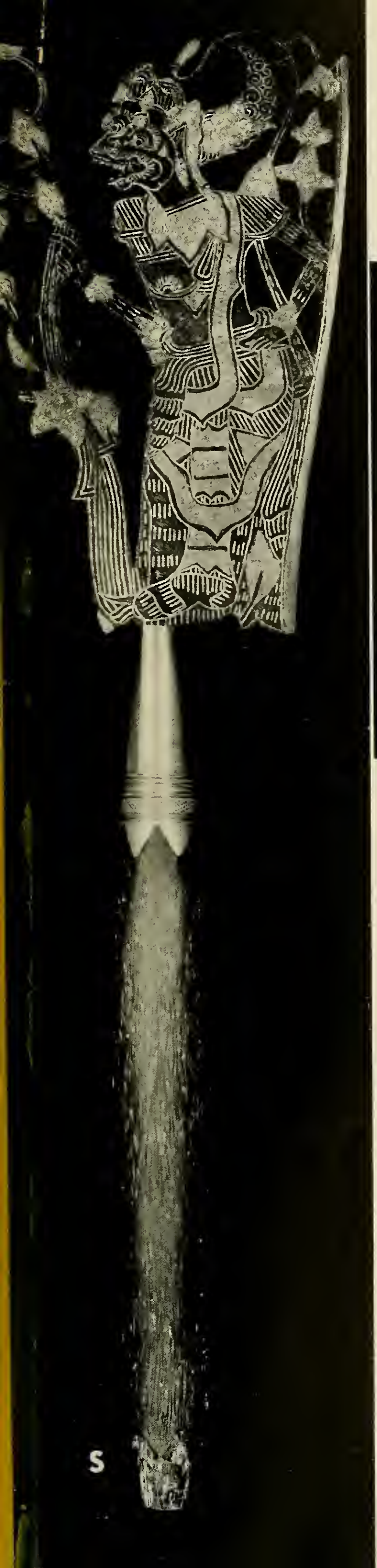
THE COVER THIS MONTH

June NATURAL HISTORY 1943
Robinson Crusoe's Army · Solomons · Earthquakes
Pastures of the Sea · Mountain Goats · Sea Otter
FIFTY CENTS

THE strange looking animal on this cover is one of the slowest "stilt-walkers" on earth. Slight movement of the spines enables it to progress over the rocks and sand of the coastal waters where it lives.

This specimen was photographed in Kodachrome by Jay T. Fox, of Seaford, L. I., and is reproduced in color about four times actual size. Some sea urchins have hundreds of small spines, almost like overlapping needles; but the one shown here specializes in a few large primary ones. Its generic name is *Cidaris,* after the name of the royal tiara of the ancient Persian kings.

Sea urchins are found in all seas, and the fleshy parts within the brittle shell are sometimes used as food. The animal's mouth is on the under side and is composed of five converging jaws. Five rows of small tube feet lead around the body to the mouth and serve to convey food to it. Because Aristotle likened the mouth to a lantern, it is called "Aristotle's Lantern."



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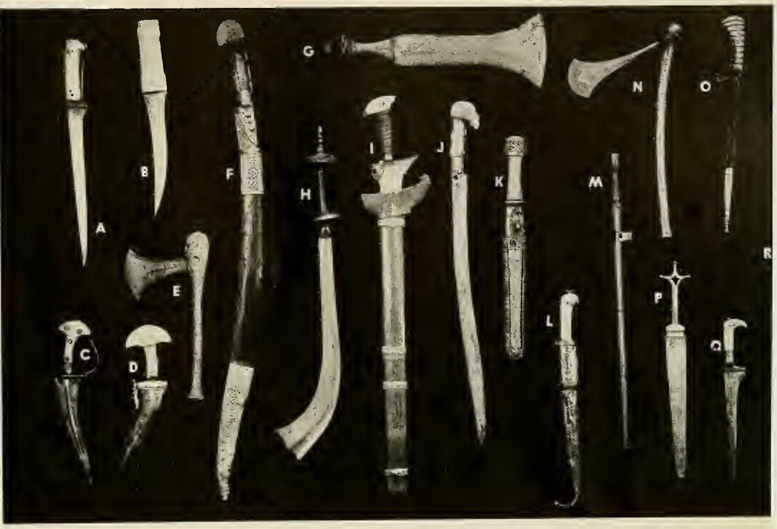

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Through Darkness to the Stars

FACED with the terrible damage and destruction inflicted upon cultural institutions everywhere else in the world, we incline to look with gloom upon the future of civilization outside of our own continent. Our more excitable commentators make estimates of centuries lost in the cultural progress of the nations most badly afflicted, and we tend to accept the estimates because our hearts go out to these people, both for their suffering in the present and for the long hardships we think we can foresee for them in the future. Often a tiny note of smugness creeps into our pity, and the feeling gains ground that we may relax in the efforts and sacrifices we make for our own cultural institutions, because of their greater physical safety. When the war is over they will still be here, undamaged in their physical possessions, while the rest of the world will have to build theirs anew. A little neglect of our cultural values while we concentrate upon the physical war effort can, therefore, not seriously handicap our position in the postwar renaissance of civilization. But such reasoning is false in its foundations and terribly dangerous in its effects.

It is in the creation of new objects and ideas that civilizations move forward, not in the possession of these things. Where the greatest physical needs and spiritual opportunities for new creation are found, there also will the greatest cultural progress be made. But that will scarcely be here when the war is over. On the contrary, our security now,—for which we must be forever grateful,—will become our liability then; and the advantage must shift to those who have been more directly exposed to the ravages of war, as a slight but just compensation for their far greater suffering. While we must struggle to overcome the complacency of safety, they are learning a new appreciation of cultural and civilized ways of life by having their right to the enjoyment of such things temporarily taken away from them or threatened at very close quarters. With this renewed intensity of appreciation they will be facing a world in ruins, in which their inventive genius can apply itself to the creation of entirely new works in all fields of human endeavor, building upon a ground which has been cleared of dust and tradition and physical obstacles, while we shall be hampered by our undamaged and outmoded possessions and our less severely tested concepts.

Countries which have been invaded and again set free and countries forced to disregard habits and traditions of centuries in the face of danger, will not simply fall back to their old patterns. Both philosophy and engineering will find new problems to solve and new goals to reach. In the task of physical reconstruction new architecture will develop. New buildings will require new ornaments and decorations. The arts will flourish, and it is unavoidable that the stimulus of such intensive creative activities must spread through all the arts and through all the intellectual efforts of man.

After a period of correction for the more elemental physical evils which war leaves in its wake, it seems certain that the suffering and devastation of other continents must soon give rise to a cultural renaissance unequalled in the history of the world. If we, on our safer shores, wish to share fully in this renaissance, we must have the vision and the courage to pioneer in spite of our possessions. And because we shall lack both their opportunities and their zeal when the war is over, it is of greater importance for us than for any others to keep our cultural institutions alive and active, alert and undiscouraged, throughout the emergency, so that they can be ready to secure for us a proper role in the great developments to follow.

A. E. Parr

Director, The American Museum of Natural History.

LETTERS

Sirs:

I am tremendously impressed with the editorial "The Museum Meets the Public."

It is the realization of your statement "this divorce between expert knowledge and public comprehension is one of the severest obstacles to the further progress of civilization," that has induced me to go so heavy into the work of offering Junior subscriptions to California public school children. I am now covering fifteen counties and am hoping to find the funds for some twelve more. C. M. Goethe.

Sacramento, Cal.

* * *

Sirs:

I am in receipt of your notice enclosing membership cards and literature. I am sorry to have to tell you that my husband died last June and I have changed my address from 62 Moorgate as indicated.

I am most anxious to keep on the subscription, but I cannot find out how this is done, as we are so restricted in the matter of sending money out of the country. My bank manager is trying to find out how it was paid since the war, and I shall be obliged if you could also tell me this. . . .

I do not know why we have never recorded our deep appreciation of the magazine long before this! It has come through most regularly in spite of all difficulties. We have now been enjoying it keenly for nearly 10 years! Just to feel its fine thick paper is a delight, with our own magazines getting thinner and thinner with the war years. It is read from cover to cover by my family and many friends as soon as it arrives. We often recall the bitterly cold day when we crossed the park in deep snow and had to thaw ourselves out gently in the Central Hall before enjoying a look round. We became members that same day, after being there for hours and being shown great kindness by some of your staff. The Museum is to me the center of attraction in New York! I look forward to the day when I shall see the Empire State Building once again on the horizon as my ship comes into the Narrows, but as soon as I am allowed on shore I shall make straight for the queer old brown stone "set-up" that holds the real beauty and treasures of America.

With best wishes and thanks to all who contribute so much care and thought to the magazine. Mary Hughes.

New Earswick,
York,
England.

* * *

Sirs:

Your June number "Sea Otter" article reads—"Have you ever seen a sea otter at close quarters?" Yes, I saw a big one lying on a large flat rock on the Pacific Coast near Cape Mendocino, California.

In the year 1872 I spent the summer at Noyo about 150 miles north of San Francisco and loved to wander along the ocean cliffs.

One morning I looked over the edge and about 50 feet below was a large sea otter fast asleep. I watched him for some time till he awoke and, seeing me, dove into the sea and made off.

M. Hall McAllister.

Redlands, Calif.

* * *

Sirs:

Although there was no notice, I believe my subscription to Natural History has expired, and so that I shall not miss an issue I am enclosing my check for its renewal.

I would like to express my appreciation, as a graduate biologist, of this magazine. Unlike so many "popular" scientific magazines, it is not written entirely for non-scientific readers so that any one with a little information feels as though he were reading a child's magazine, and yet my friends without advanced scientific training enjoy it as much as I do.

I know that pleasing two such opposite groups is a difficult task and one which Natural History is doing very well.

(Mrs. James) Jane W. Morton.

Drexel Hill, Pa.

Sirs:

A short time ago I became acquainted with your publication Natural History. I have read several issues kindly loaned me by a friend and I am convinced that it is the finest periodical of its kind published.

For people having a great amount of reading to crowd into a limited amount of time, these charmingly written articles fully satisfy the reader without his having to wade through a welter of the writer's emotional reactions.

Please accept the enclosed amount for one year's subscription to Natural History Magazine. J. E. Price.

Fort Collins, Colo.

* * *

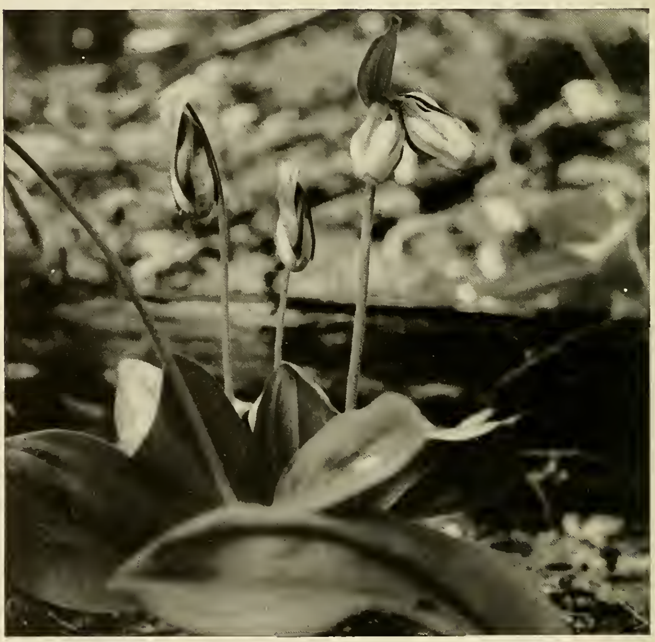
Sirs:

Your Magazine is my most prized possession. . . . I particularly enjoyed the story of the Wood Ibis, for I have spent much time watching them in Florida. . . .

I watch eagerly for every issue. . . .

(Mrs.) S. A. Gile.

Minneapolis, Minn.

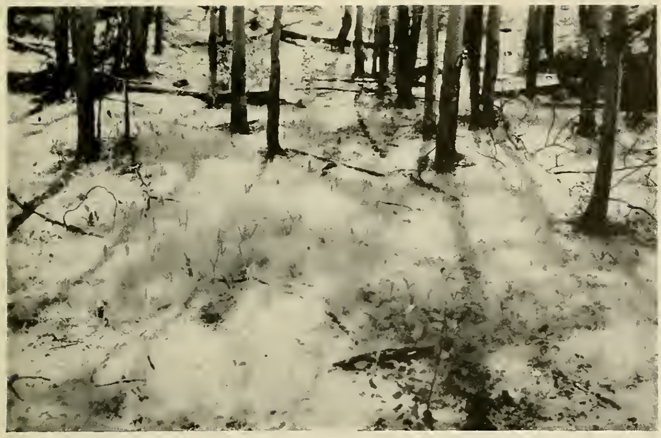


Sirs:

This picture shows a double-flowered *Cypripedium acaulis,* which blossomed in woods near my home in June, 1942. It was part of a colony of 25 blossoming plants and was one of a closely growing group of three blossoming plants. This June there was still the unusually large blossoming colony, but that special group that had had the double flower had been chewed off by some animal to within a few inches of the ground. I thought the picture might be of interest, as no one to whom I have shown it had ever seen or heard of a double Lady's Slipper.

(Mrs.) Evelyn Bolles Phenix.

Chocorua, N. H.



Sirs:

Enclosed is a photo taken on July 4. The Cottonwood lint was still "flying," and on this morning I went on a hike. This particular spot was in a hollow on top of a mountain. It seemed as though the drafts hit this particular place and deposited it.

The lint was over 3 inches deep and had the appearance of snow.

It was quite an unusual sight in spite of the fact that last week there was snow on the mountains.

Pvt. Thano A. Johnson.
Camp Hale, Colo.

Cottonwood lint is the silk hairs of the seeds, which are scattered by the wind, and it gives the trees their common name.—Ed.

* * *

Sirs:

I was extremely surprised and gratified to receive a copy of your magazine a week back. It was the March 1943 issue and it arrived here intact in a remarkably short space of time. I am in civilian life a biologist and you can imagine, therefore, how welcome any current literature on Natural History is to me. I don't know how you came to send it to me, but I sincerely hope you will continue to send the magazine in the future. Thank you so much.

(From a Prisoner of War.)
Somewhere in Italy.

* * *

Sirs:

Sorry I didn't get time to renew my annual membership in the Museum the last time I was home, so am writing my mother to send you a money order for $10 to renew it as from March, 1943, to March, 1944. Since becoming an Annual Member I haven't had much opportunity to attend the free lectures but I certainly do enjoy reading Natural History Magazine and I would greatly appreciate it if you will send me the numbers from March, 1943, to the present date.

I am still employed as radio officer on one of the "Liberty" ships of the U. S. Merchant Marine, and reading is about our only relaxation when at sea.

Forman Lester Godown.
Ringoes, N. J.

Sirs:

May I take this opportunity to say that I enjoy every issue of this magazine and look forward to receiving it each month. It has proved to be not only extremely interesting in the wide variety of subjects in its particular field but also very enlightening in the articles on such places as the Solomon Islands, etc., which, to most pople, were practically unknown until the war brought them to our closer attention.

Ethel Towers.
Syracuse, N. Y.

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MARTINIQUE

By Cecilia M. Egan

I HAVE been a subscriber to Natural History for several months and have found particular interest in your articles on the islands of the war zone. Martinique, while not actually in this category, is prominent in the international situation and important because of its strategic position on the approach to the Panama Canal. I spent some time there in 1939 and witnessed some very interesting things.

Martinique has a persistent fascination that makes it merit its name of "L'Ile des Revenants"—the isle of those who return, and with a double meaning, the isle of ghosts. For Columbus himself and the names of many others who have added color to the pages of history are interwoven in its past.

In some sections they still practice the old rites, which they call Indian though they are more Neo-African, and directly related to the Voodoo of Haiti and the Macumba of Brazil. I was fortunate enough to witness one of these ceremonies.

I scarcely realized just what was in store when a creole couple I had met there invited me to drive to St. Pierre with them the following morning to see some native "dances," as they put it. Of course I was delighted, but my enthusiasm was somewhat dashed when they said that they would pick me up at 4 A.M.! Nevertheless, I surprised myself by being ready when the car pulled in sight. It was already light, and the drive over the new highway through the lush mountains was beautiful. The road was one S-curve after another, with no letup for two hours. It had been rushed to completion, and one of the current laughs of the island was the fact that the telephone poles had been cut and set in so rapidly that they had taken root in the fertile soil and had begun to sprout new branches all the way up. We had breakfast in St. Pierre with a friend of my hosts, a Frenchman who had had his native cottage in France shipped over and reconstructed on a hill in full view of Mt. Pelée. Finally about nine o'clock we started down to the clearing at the foot of the hill where the ceremony was to take place. Then it dawned on me that this was one of those rites that are fast becoming extinct. The people did not object to our being there. They were acting in good faith and accepted as a matter of course that others would be. It was clear that they had never been ridiculed or looked upon as strange.

About 40 spectators of all ages waited near the road. The actual participants numbered only eleven, all under 30 years of age, to judge by their appearances. There were four drummers, also one woman and the priest, his two assistants, and three male dancers.

Off to the left we heard the sound of the drums, high-pitched and metallic. I learned later that they were made of goat skin stretched over a circular frame. The men held them in the crook of the left arm and beat them with small whiplike branches. The sound was decidedly unpleasant and continued uninterrupted throughout the whole ceremony. Soon the drummers appeared, abreast, and behind them a majestic negress bearing a great tray of food on her head. They moved slowly down the road toward the temple where the priest and his assistants waited. The procession circled two or three times in the space between the open door and a little stone altar that stood a few feet in front of the entrance. Then the drummers stepped to one side and the priest took the tray of food into the temple for the gods. Four or five images were leaning against the walls inside the tiny building. They were made of lightweight wood, about three feet high. They were very primitive in design and were painted a violent yellow with red and black outlines. However, the stone idol outside was more durable and was doubtless of early origin—a sculptured head about fourteen inches in height. Beside it and not quite twice as high was an oblong stone block, the top hollowed out and filled with a yellowish oil in which the priest burned wicks and fresh flowers later in the ceremony.

Unfortunately the original temple had been destroyed the previous year, and they had replaced it by a hideous cylindrical structure made entirely of sheets of corrugated zinc. It was startlingly but innocently reminiscent of innumerable Paris street corners.

With the exception of the dancers, the participants wore no particular costume—shirt, trousers, old fedora hats or none at all, bare feet. The only concessions that the priest himself made to ceremony were a red and white printed apron and a white cloth tied over his nose and mouth while he was serving the gods their food. This consisted of bananas, a variety of squash, and rice cooked in coconut milk. One of the assistants lit a fire with a twentieth-century match and set the rice to boil in a pottery jug and a gallon tin. While they waited for the food the other assistant prepared a ram for the sacrifice. It was a great bull-necked creature. First they poured water over his back as a sign of purification; next a tray of some smoldering substance was wafted under his nose several times so that he was forced to inhale the smoke; finally the priest tied a garland of pink flowers around his neck—all with much bleating protest and pulling at the short rope.

By this time the food was ready and the altar fixed for the offering. The wicks and blossoms were burning in the hollowed stone, a lighted candle stood near the idol, and bright banana palms had been spread before it. The priest covered his nose and mouth with the mask and slowly spooned the gleaming rice on the green leaves. Now that the food had been offered, the priest was ready to com-

he Isle of Those Who Return

A.M.N.H. photo

Martinique, strategically situated on the approach to the Panama Canal, constantly fascinates visitors with its colorful native ceremonies. It has won for itself the name of "L'Ile des Revenants"

municate with his god. Removing the mask, he went into the temple and took up a very small drum made as though the points of two cones had been lopped off about one-fourth of the way up and the cut surfaces fastened together to make a single drum with a head at each end. He held it in the center and used it like a primitive telephone, talking into one end and then gluing the other to his ear to receive an answer from the god, whose message he relayed to the people outside. Up to this time, what little talk had gone on was incidental to the ceremony and had been in French or creole; but now the language of the priest was incomprehensible to me. Some of the spectators declared that he was using the old, old Indian tongue of the island. The priest continued his conversation for about ten minutes, and with each successive exchange of words between himself and his god his speech became quicker. His voice rose higher and he grew more and more enthusiastic, gesticulating wildly, until he worked himself into a veritable frenzy that left him weak and trembling. Finally he stepped out into the light and began a sort of agitated dance, hopping from one foot to the other, seemingly tottering with weakness. His two assistants held a great machete between them, the sharpened edge up. The priest stepped on it and stood for some minutes shifting his weight from one leg to the other with no apparent damage to the soles of his feet, and that blade was *sharp*, as they proved shortly! However, his hands rested on the heads of the two men and his weight was no doubt more there than on his feet. At any rate the effect was good, and the expression of his face was that of a man in agony. As soon as he jumped down, he took a bit of fire in the palm of his hand, put it in his mouth and, with his head thrown back, let it burn for a few seconds, then swallowed it.

Once again the ram was submitted to the water and smoke. This time they sprinkled a fine powder over him, and the rope was placed high on the head and pulled taut, leaving the neck free. Then with one magnificent, lightening stroke of the machete, the assistant priest decapitated the animal. (It was said that there were only three or four men left on the island who could perform this feat.) At once the head was placed on the altar with the right hind foot and a piece of the flesh from the leg. The other assistant threw himself face down in front of the idol and, supported by his toes and his hands, raised and lowered his body several times in worship and prayer.

There remained only the dancing to finish out the ceremony. The sharp sound of the drums was complemented now by the deeper tones of a small barrel drum that a player slung over his shoulder and beat with agile fingers, plus the rhythmic click-click of two small stones that another tapped together. Three white-clad dancers stepped into the clearing. The oldest might have been 25, the next almost 20, and the third a boy of about ten. The costumes, similar and somewhat makeshift, increased in ornateness with the age and importance of the wearer. The straight-cut skirts hung about knee length. Pieces of painted wood, cut in varying shapes and strung on cords that tied behind the neck, hung to the waist in front like segmented plastrons. The headdresses of the two younger ones were decorated with many crudely cut

Continued on page 96

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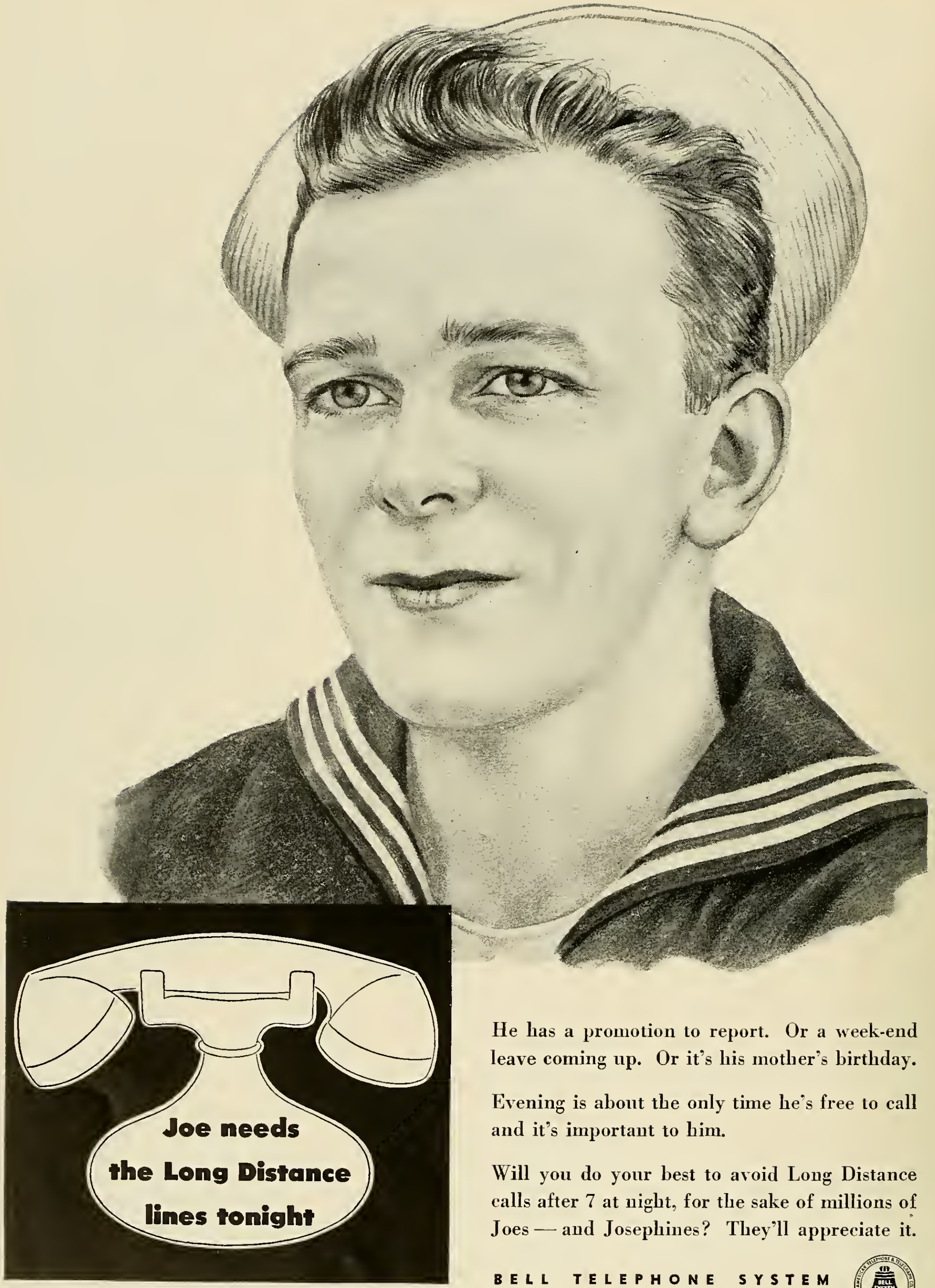
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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LII—No. 2 — SEPTEMBER, 1943

Working For Victory .... Cover Design

From a Kodachrome by Ruth Gruber

An Eskimo Army seamstress of Alaska chewing the sole of a sealskin boot she is making for our armed forces in the north

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The struggle for territory in the animal kingdom

Clover Hobby .... Mark Barr 96

A challenge for anyone who would set a new record in four-leaf and other rare clovers

You will find Natural History Magazine indexed in *Reader's Guide to Periodical Literature* in your library

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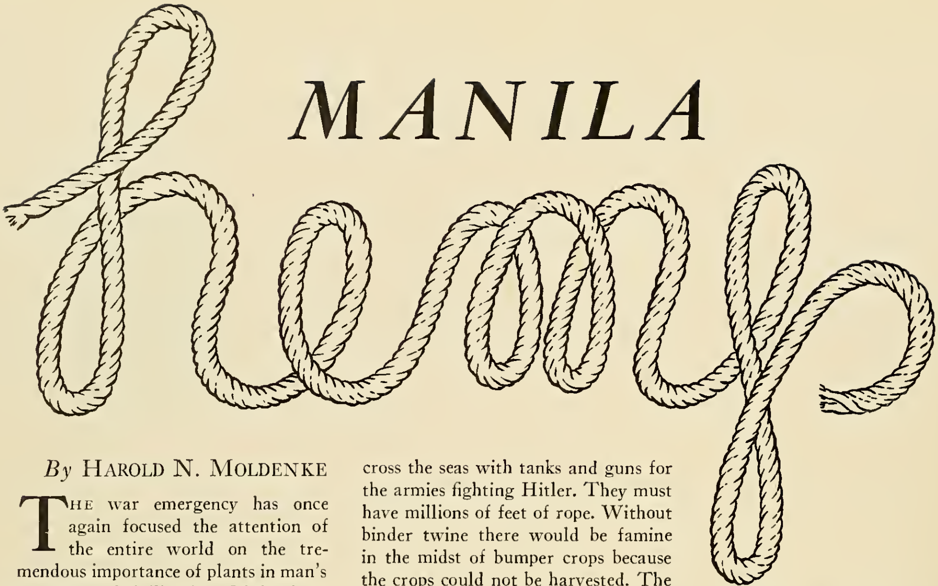
MANILA hemp The



By HAROLD N. MOLDENKE

THE war emergency has once again focused the attention of the entire world on the tremendous importance of plants in man's economy and civilization. Of the thousands of kinds of plants used by man, some are so important to our present war-effort and so irreplaceable (or almost irreplaceable) as to have earned for themselves the designation of "strategic plants." This places them in a rank co-ordinate with that of the "strategic minerals" described in a previous series of articles in this magazine. Without an adequate supply of these plants or their products it will be difficult, if not impossible, to win the war. Foremost among such are the fiber-producing plants.*

If all the articles and products manufactured from plant fibers were to be suddenly eliminated from the face of the earth, civilization as we know it today could no longer exist. The number of articles made from plant fibers found in every home and shop, in every factory and mine, in every school and hospital, on every farm and ship, is legion. The Office of War Information has truly stated: "These unromantic-sounding fibers are essential to the United Nations. Without them we could neither fight nor eat. Without rope no warship could race to do battle against the Nazis and the Japs, no cargo ship cross the seas with tanks and guns for the armies fighting Hitler. They must have millions of feet of rope. Without binder twine there would be famine in the midst of bumper crops because the crops could not be harvested. The farmers who grow the food we eat must have hundreds of millions of feet of binder twine for their harvesting machines."

Fiber-growing has thus become one of the most extensive agricultural and industrial undertakings of the Western Hemisphere in many years. Fiber plants were originally scattered by nature quite widely over the face of the earth, but because of the difficulties involved in processing fibers, hitherto requiring extensive hand labor, the cultivation of fiber plants has been concentrated in the Eastern Hemisphere where labor costs are very low. The occupation of the Philippines, Netherlands Indies, and Malaya by the Japanese and the difficulties of securing supplies from unoccupied fiber-producing areas in the Orient because of shipping hazards, render it essential that the Americas begin to raise their own fibers. The program to add many thousands of tons to our annual fiber production in the Americas arose largely from the recommendations adopted at the Rio de Janeiro Conference of American Foreign Ministers in 1942.

New York Botanical Garden photo

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*The writer is deeply indebted for copious material on this subject to Mr. H. T. Edwards of the Division of Cotton and other Fiber Crops, Bureau of Plant Industry, to Mr. C. O. Erlanson of the Division of Plant Exploration & Introduction, Bureau of Plant Industry, to Mr. G. L. Wittrock, Mr. Joseph Monachino, and to the releases of the Office of the Co-ordinator of Inter-American Affairs and the periodicals, *Agriculture in the Americas* and *Science News Letter,* which have been freely drawn upon for material in the preparation of this series of papers.

THE FIRST OF A SERIES OF ARTICLES ON STRATEGIC PLANTS

The leading product of the Philippines is a plant fiber of vital importance to the United Nations in the war

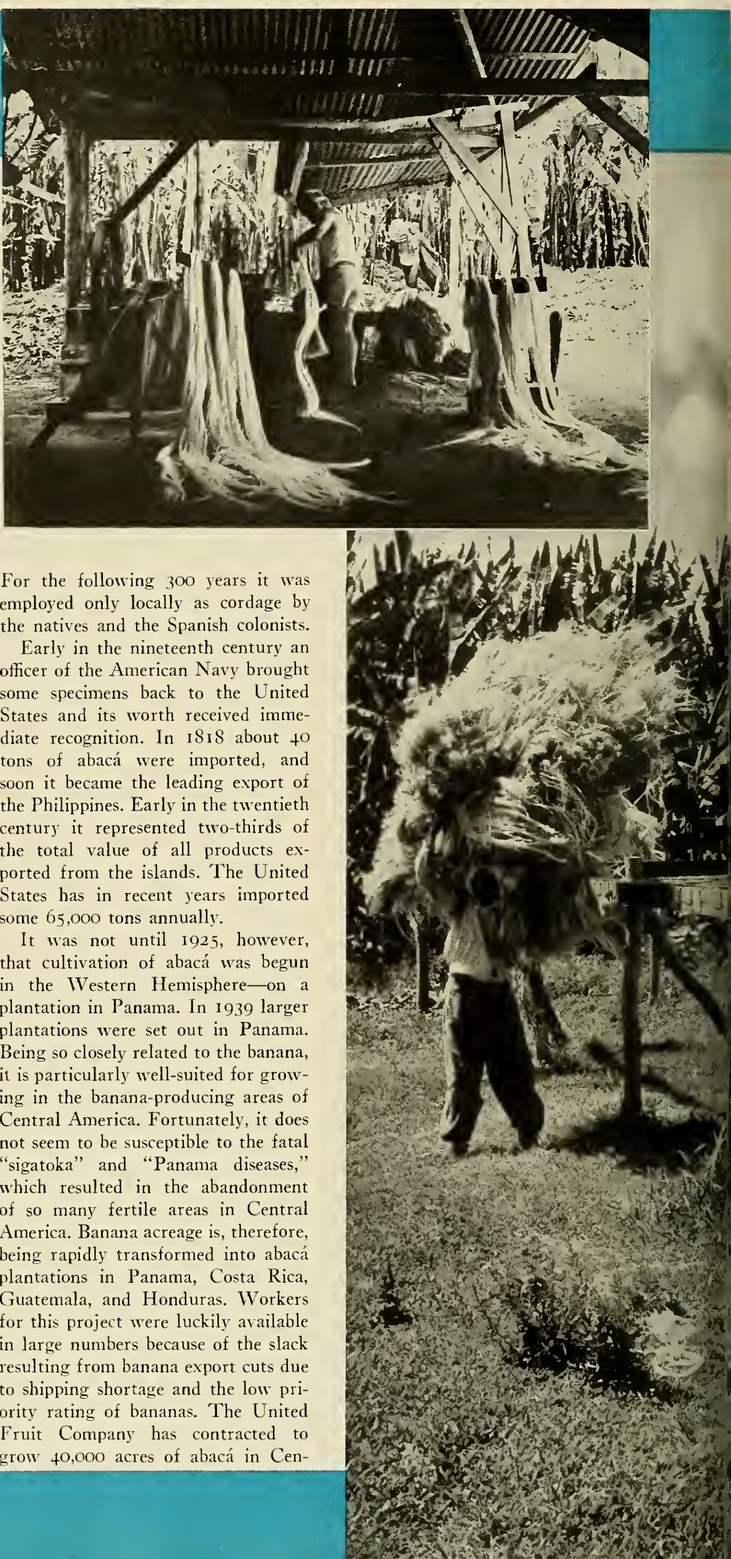
Lifeline of Our Forces at Sea

◄THE ABACÁ PLANT from which the unexcelled Manila rope is made greatly resembles the banana plant, to which it is closely related. But unlike the banana, it has not previously been cultivated extensively outside of the Philippines, and the shortage presents a serious problem

Official U. S. Coast Guard photograph from International News Photos

➤ MANILA HEMP being processed by natives at the edge of a plantation on Mindanao Island, Philippines

Fenno Jacobs photo from Three Lions



Nearly two thousand species of plants yield fibers useful to man. These are usually classified in three groups: (1) *hard or structural fibers*—the veins or fibrovascular bundles extending from the stems through the pulpy tissues of the petioles and leaf-blades, found almost exclusively among the monocotyledons; (2) *soft or bast fibers*—those found in the inner bark (the layer between the epidermis or outer bark and the inner stele or woody portion) of the stems, found in gymnosperms and dicotyledons, and (3) *seed fibers*—those produced on the inside of seed pods.

Most important of the hard fibers is abacá or Manila hemp. Actually, it is not a true hemp and it is not grown in the immediate vicinity of Manila. The name "hemp," however, has unfortunately been used very loosely for many years until now in some quarters it is almost synonymous with "fiber." The word "Manila" in the name derives from the fact that the product was, in pre-war days exported to the world from Manila. The Malayan native name for the fiber, "abacá," is less misleading and, therefore, preferable.

The abacá plant *(Musa textilis)* is a perennial plant, native and endemic to the Philippine Islands, and closely related to the banana *(M. paradisiaca* var. *sapientum)*, which it greatly resembles in appearance. A mature abacá plant attains a height of 20 feet and consists of a group of from ten to thirty "stalks" or "pseudo-trunks," each composed of the overlapping leaf-stems, arising from the bulbous underground stem. The outer portion of the leaf-stems, or petioles, contains the fiber. The flower-spike is short and drooping. The inedible banana-like fruit is only two or three inches long, 3-angled, curved, green, and filled with black seeds. Plants produced from the seeds do not run true to type, so the usual method of propagation is a vegetative one, by means of suckers or rootstocks.

The famous explorer, Ferdinand Magellan, recorded that the abacá plant was being grown and used in the Philippine Islands when he visited there early in the sixteenth century. For the following 300 years it was employed only locally as cordage by the natives and the Spanish colonists.

Early in the nineteenth century an officer of the American Navy brought some specimens back to the United States and its worth received immediate recognition. In 1818 about 40 tons of abacá were imported, and soon it became the leading export of the Philippines. Early in the twentieth century it represented two-thirds of the total value of all products exported from the islands. The United States has in recent years imported some 65,000 tons annually.

It was not until 1925, however, that cultivation of abacá was begun in the Western Hemisphere—on a plantation in Panama. In 1939 larger plantations were set out in Panama. Being so closely related to the banana, it is particularly well-suited for growing in the banana-producing areas of Central America. Fortunately, it does not seem to be susceptible to the fatal "sigatoka" and "Panama diseases," which resulted in the abandonment of so many fertile areas in Central America. Banana acreage is, therefore, being rapidly transformed into abacá plantations in Panama, Costa Rica, Guatemala, and Honduras. Workers for this project were luckily available in large numbers because of the slack resulting from banana export cuts due to shipping shortage and the low priority rating of bananas. The United Fruit Company has contracted to grow 40,000 acres of abacá in Cen-

▼ ENORMOUS BUNDLES of the fiber that will be made into Manila rope are carried out to the drying racks on the backs of the native workers of Mindanao Island

Fenno Jacobs photo from Three Lions

tral America and expects a yield of at least 40,000,000 pounds of dried fiber annually. Already about 20,000 acres have been planted in Panama, Costa Rica, Honduras, and Guatemala. Much of this land had formerly been used for banana plantations but was abandoned when diseases destroyed the bananas. Now it must be reclaimed often from a semi-jungle condition, cleared, drained, and burned-over before planting can begin.

The essential seeds and cuttings for establishing this new crop in the Americas were, fortunately, brought from the Far East by farsighted United States Department of Agriculture botanists before the Japanese occupied the Philippines and the Netherlands Indies (which also produced abacá commercially before the war, although in quantities decidedly second to the Philippines).

The combination of great strength, durability, and high resistance to water (in which it will not swell), makes abacá the most valuable fiber known for the production of naval and marine cordage, where it is almost irreplaceable. It makes by far the strongest rope known for use in and around salt water. Besides its use by the Navy and Merchant Marine for hawsers, rigging, etc., it is most valuable in industry and agriculture as rope. Its use (like that of all hard fibers) is now strictly limited by War Production Board rulings to the most essential war needs.

The tough pliable fiber of abacá is difficult to "clean." In the Philippines the outer fibrous portions of each petiole are stripped off in the form of ribbons. These ribbons are then drawn between a dull knife which rests on a block of hard wood, in order to remove the pulp and other waste materials. In the southern portion of the islands a small machine is used, which works on the same principle. The comparatively high cost of labor in the Americas makes all hand-stripping and cleaning impractical, so here the large decorticating machines of a type formerly used in Sumatra are being employed. These, with complete equipment, cost some $15,000 each, but can be used both for abacá and sisal (a fiber which will be discussed in the next article in this series). At least 2000 acres of plants, however, are needed to keep one machine in full operation. Operators in the East Indies ran their machines on a 24-hour-a-day basis to reduce

Fenno Jacobs photo from Three

↑ VITAL FIBER of the abacá plant drying in the sun on Mindanao, now in Japanese hands

← A MORO adjusting the fiber on a drying rack in the Sulu Archipelago: a stage in the manufacture of a product which the Philippines shipped to all parts of the world in peace. The world at war needs more and has less

Ewing Galloway photo

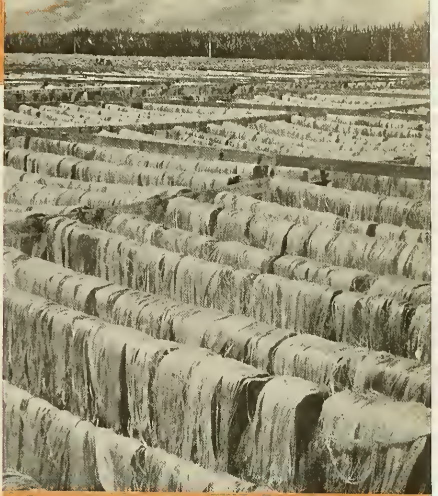
overhead costs. It is necessary, therefore, to cultivate the plants on a really huge scale in order to be commercially practical. When the projected 40,000 acres in Central America reach maturity they should be able to provide for a considerable part of the United Nations' abacá requirements.

Some eighteen months are required for a new planting to reach maturity and begin yielding fiber. In the meantime, reserve stocks are being very rigidly conserved, and substitutes are being sought. One of the most promising substitutes is the soft fiber, ordinary hemp *(Cannabis sativa)*, which will be discussed in detail in a subsequent paper in this series. Sisal rope, treated with a new preservative, is also being used as a substitute for abacá on ships. The preservative gives the rope resistance to wear, as well as protection against marine organisms.

The actual fiber of the abacá plant comprises only 3% to 4% of the weight of the stalk. This means that in order to obtain 1000 tons of fiber, 25,000 or 30,000 tons of stalks must be transported to the decorticating establishments. To expedite this, permanent or temporary railroad lines are being built and small diesel engines used for the hauling. Speed is of vital importance, because the stalks should be processed within 48 hours after being cut. This is accomplished by running them through heavy rollers, which crush out the water content. The fiber is then separated from the waste material by a decorticating process. Motor-driven conveyors, pumps, and baling machines are employed, as well as artificial driers. Adequate housing, sanitation, and hospitals are being provided for the thousands of workers—all of which attest to the importance attached to this undertaking by the American governments involved.

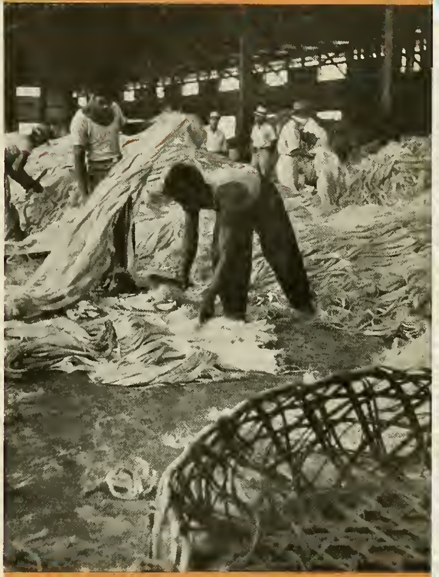
In addition to the large plantations, there are numerous smaller plots being raised by individual farmers, often by their own more primitive methods.

[*Next month: sisal, Salvador sisal, henequén, cabuya, and other hard fibers.*]



Fenno Jacobs photos from Three Lions

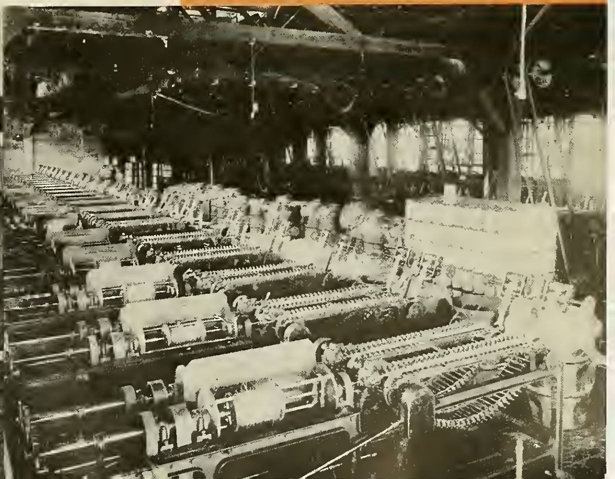
➤ THE ABACÁ PLANT was being grown and used by the natives even in Magellan's day, but production was small compared to the thousands of acres given over to the needs of an industrial age



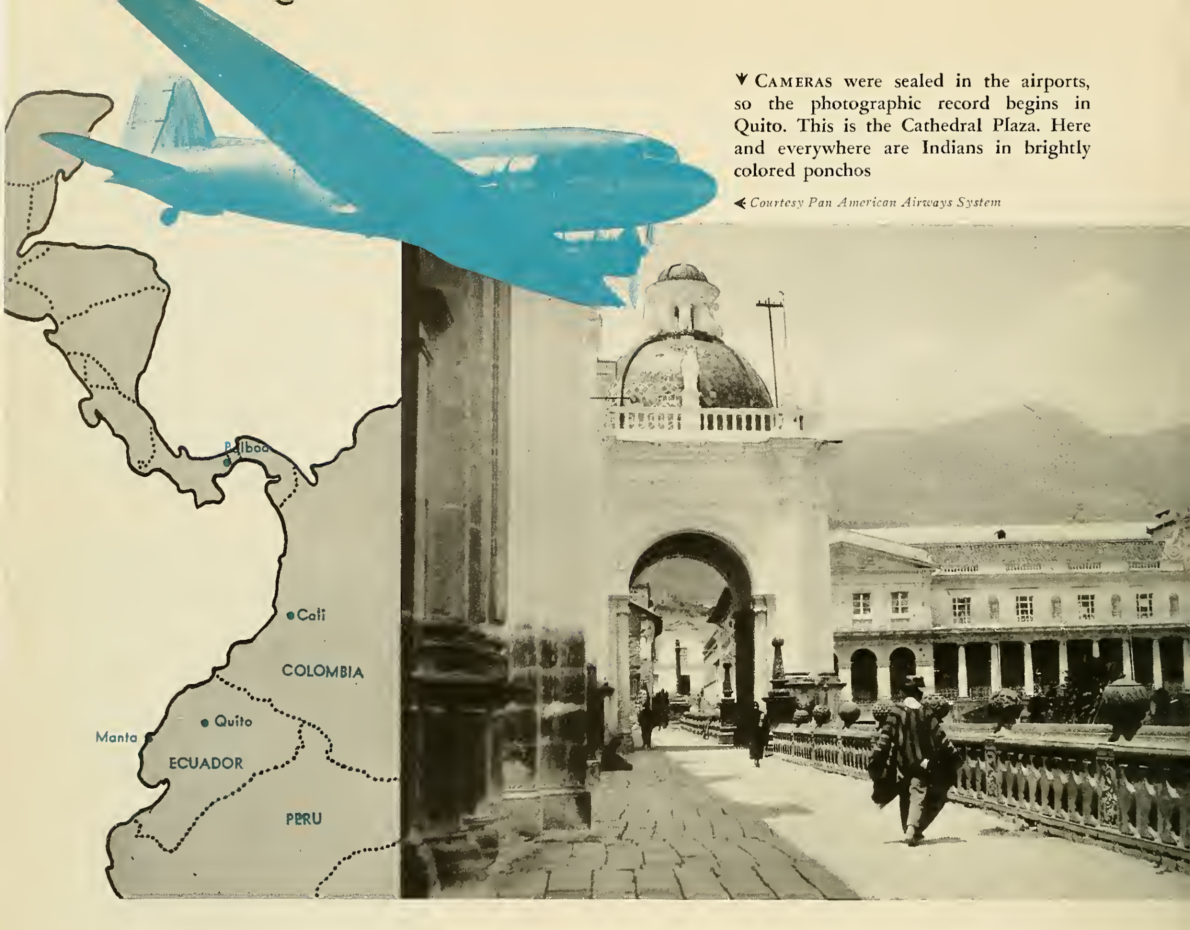
➤ THE STRATEGIC PRODUCT being bundled for shipment in the Philippines

Ewing Galloway photos

▼ UNLOADING MANILA HEMP from an interisland ship on the waterfront at Manila



▼ INTERIOR OF A ROPE FACTORY in Manila, showing the machines which wind the strands on spools preparatory to final twisting into rope. In response to the needs of war many thousands of acres of abacá are being planted in Latin America



▼ CAMERAS were sealed in the airports, so the photographic record begins in Quito. This is the Cathedral Plaza. Here and everywhere are Indians in brightly colored ponchos

◀ *Courtesy Pan American Airways System*

FLIGHT TO ECUADOR

The speed of modern travel lent a magic charm to the scenes and adventures that unfolded on this journey to a tropical village at the foot of the Andes

By
GRACE E. BARSTOW MURPHY

EXPERIENCE is not measured by time but by intensity and effect. The long trip is not necessarily the most important one. I found this true in my flight to Ecuador.

Quite aside from why I went, this journey which began one week and ended the next was one of the most surprising and interesting things that ever happened to me. Every waking moment of the 8000-mile trip was packed full of high-voltage experience; every sleeping moment brought rejuvenating rest.

My husband, Robert Cushman Murphy, had been on one of his expeditions off the coast of Colombia and Ecuador for two and one half months. The American Museum of Natural History sent me on an official mission to join the Expedition on one of its infrequent landings. His oceanographic work and the Museum's affairs in sending me are not my story; I write solely of my own trip as it stands vivid in my memory today.

Probably not many almost wholly deaf women have ever taken such a trip as this one, entirely alone. As the thought of each of these thirteen days speeds through my mind, each moment as clear-cut as the line of the Andes against a cloudless sky, it seems as though the happy associations of my trip broke through the wall of my deafness with an eagerness doubled by it.

On Sunday, my son brought Harvard classmates to dinner in New York. On Wednesday I was plowing through the intricacies of a Spanish meal in a primitive town on the coast of Ecuador, below the equator.

On the first lap of my trip I said to my hostess in Miami, "The Panama Clipper leaves at 6:45 A. M. Are we near the airport?"

"Very," she said.

"Is it surely the right airport?"

"Yes, only ten minutes away."

"Well, I wish to get there by 6:15," said I.

So we got there at 6:15—finding

no activity whatever. I showed my ticket. The agent jumped:

"You are at the wrong airport. The right one is fifteen miles away!"

I hauled out my Museum credentials. It was then 6:20. "They must hold the clipper, or I'll miss all my connections and Doctor Murphy when he lands in Ecuador."

The taxi that was hurriedly called drove at sixty. At the airport they rushed me through the formalities and—five minutes late—the clipper rose, with me on board.

If you don't believe in Heaven but would like to, fly over the Caribbean in the early morning sun. You'll be like the man who was asked if he believed in infant baptism: "Believe in it!" he said, "I've seen it done!"

My notes, jotted as we flew, read: "Looking out from the little window of the clipper, my seat carefully chosen behind the wide wing where views are unobstructed, there lies a paradise of beauty beyond anything my beauty-loving eyes, which help make up for my ears, have ever witnessed . . . Views change faster than my pencil can keep up with them. Leaving the inland airport, we are soon over the sea, following the lovely Florida Keys, with their colors, varying from purple through all the shades of lavender and blue to green. Then into the clouds which glaze the windows, and above them into the sun . . .

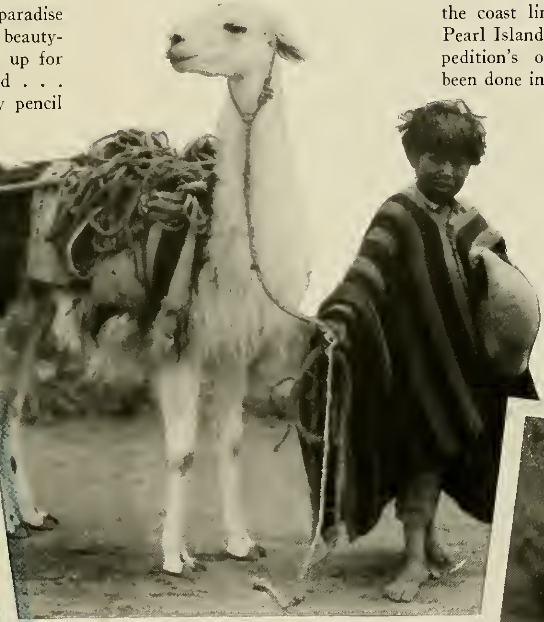
"The clouds spread out as a definite and solid entity with, nevertheless, a delicacy not at all of the earth. Shapes like hills and mountains tease the imagination, as they rise above the cloud-terrain—shapes which cast blue shadows . . .

"We are flying at fourteen thousand feet, between two skies, the upper one definitely nearer than I have ever seen it before. Here and there an opening gives a glimpse of the sea two and a half miles below. Little cradle clouds appear to lie upon the water . . .

"Herman Melville, in *Moby Dick,* describes in stirring words the quality of whiteness. The whiteness experienced by a flier surpasses anything on earth. Snow seems but dull stuff compared to this infinite sea of clouds, where the very softness increases the shining quality and blue shadows enhance the purity. Variety of form and arrangement hold the eye, until one's soul becomes a part of a cosmic unity of white perfection — an experience sufficiently absorbing to negate forever, at least to some degree, the tribulations of lesser and lower levels of existence . . . The occasional sea flows golden, and the shadow of the plane, in a glistening halo, flies below like a heavenly sprite."

The Captain took me into the cockpit to see all the charts of his course, out of courtesy to the Museum.

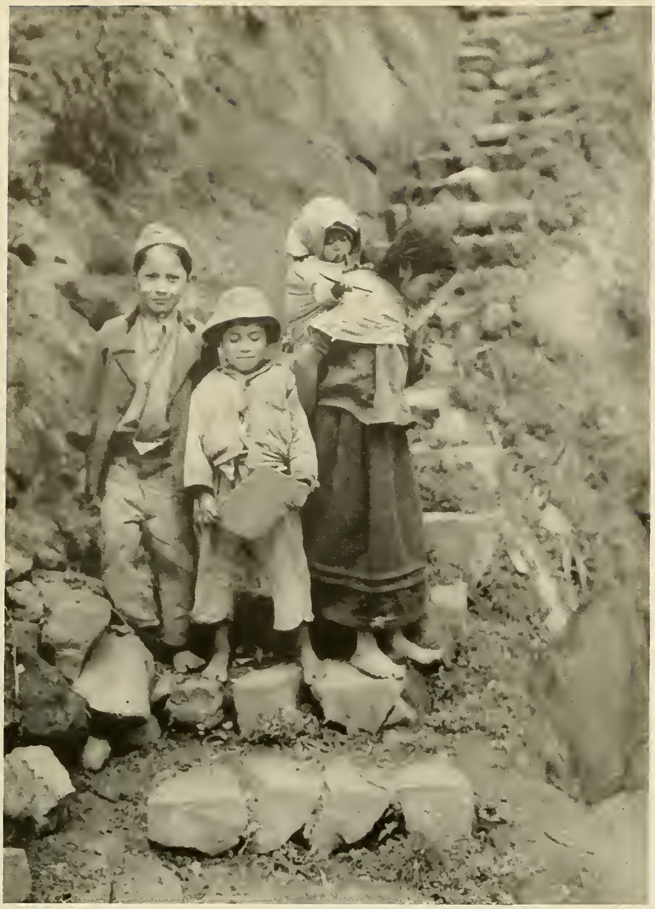
Out of the clipper at Balboa, and into a smaller plane, we were off at once for Cali, Colombia. We followed the coast line, looking south to the Pearl Islands, where some of the Expedition's oceanographic work had been done in February.



▲ THIS YOUNGSTER must have borrowed a tall father's poncho! The white llama was the leader of his train

◄ WARMLY COVERED SHOULDERS and bare feet—often bare legs, too —are the order of the day in the high Andes

► BABIES dress like the grownups, the costumes of all denoting their respective villages. The bright eyes, however, are ubiquitous



▲ IN THE HILLY OUTSKIRTS of Quito, long flights of stone steps look ancient and picturesque. Little girls help care for the babies

The Captain explained to me that we had to leave the coast and work inland in order to be within safe reach of the airport of Medellín. The wild scenery below emphasized the Captain's words. We were now looking down from the cool heights of 11,000 feet into the dense equatorial jungle. It seemed almost like trespassing, to get a good idea of real jungle without trial and toil of heat, insects, and hard going. But we, in our heights, missed the detail of tropical birds and flowers which makes such toil worth-while.

Rolling hills gave way to wild, deep-cleft valleys and razor-backed ridges. Lakes here and there were strangely edged with vivid green, doubtless some tropical water plant or alga. Finally, farmlands appeared. "One wonders what the farmers grow and how they live, and one regrets too varied experience and too many unanswered questions packed into one single day of living. It is like looking at the index of a book, with no time for hungry perusal of a single separate chapter. The mountains are increasing in height. They will exceed 20,000 feet near Quito tomorrow."

The Cauca River Valley, along which we were now flying toward Cali, was broad and fertile, hill-edged. We dropped down among the birds once more. The valley narrowed. Our wings almost touched the wild hills as we circled into the airport.

"We drive down, through avenues of palms and flowers, to town. A friend I have made on the plane, wife of the Chief Pilot of all Panagra, takes a room in the hotel connecting with mine. I discover to my delight that there are no shower curtains, and each shower, if turned on, would drench the whole bathroom. There is something very refreshing in the South American attitude of ease toward detail."

My friend and I hired a taxi for an hour and drove through the lovely city with its houses of every color of the rainbow, garlanded with vines of flowers. The main thoroughfare consisted of two boulevards divided by a river bordered by trees covered with flaming red flowers, which I learned are apparently relatives of the lowland balsa that supplies the lightweight wood. The promenades, brilliant colors, sunshine, and fresh warm breeze blowing down from the mountain made it seem more like a stage-set than a thing that was happening to me.

Later in a bookstall I saw a *New York Times* and hurried to it. The issue of February 24th was hopefully awaiting sale on April 1st. Well, why not? Perhaps the wise South Americans know more about time than we do.

Everyone gets up early in Cali, which again suggests a good use of time. The town was alive soon after we were called at four. It was 320 miles to Quito, one hour and forty minutes, as against the old way, two weeks, by mule-back. The new highway will strike a happy medium. "Up, up, out of the fertile Cauca Valley, to 12,000 frosty feet, and the Pilot obligingly wiggles the plane's wings to let us know we are crossing the equator.

"And now I am in Quito, my earthly Mecca, over which Bob and I have had many an argument for fifteen years. He had been to Quito and I had been to Arequipa, in Peru. Each insisted neither could surpass the other. We were both right, for they are equal—beautiful white cities, cradled in snow-mountains, full of the picturesque mountain life of the Andes."

So here again were gay ponchos on the men, women with babies fastened to their backs in bright shawls, donkeys with huge packs, and baby donkeys trotting along beside their mothers. One's eyes snapped pictures everywhere for memory's future use.

There were several hours between planes, and I said to the Grace Agent: "I want to see all I can of Quito this morning. What is the best way?"

"I know the very man for you. Sr. Santos has been in the States and is now a travel agent here."

A wiry Ecuadorean soon dashed up the steps, and we hurried back to his car. By the time I had said, "I will sit in front with you, to hear better and see more," we were in perfect accord, he as eager to show me everything as I was to see.

Outside and above the city, picking my open camera off the seat, I said: "Wait a moment; I want that bridge over the *quebrada*." Jumping out, I ran up the hill, snapped the picture, and hurried back. I noticed that he looked at me quizzically. Late in the day, wedged between an American and an Englishman on the way back to the airport, I heard the two men discuss the effect of the 10,000-foot altitude.

"Good gracious," I said, "I've been running all day and never thought of it."

We all burst out laughing. We could not decide whether my escape from the usual effect was due to my enjoyment and fun, or whether I had been permanently acclimated 16 years ago in Peru, when I had had a bad case of *soroche*, or mountain-sickness, at 16,000 feet.

Quito was founded about 1530 and was for a long time the art center of the New World. With the usual Catholic background of South American cities, the ancient church art is particularly beautiful. The Jesuit cathedral is probably the most beautiful Catholic church on the two continents. The gold leaf and silver altar casings, united with gorgeous colors and medieval carvings and paintings, create an effect that stuns. Other treasures and archives are contained in the Franciscan cathedral, which is almost as beautiful, and in the University. In our smug North American way, we forget the greater age of these South American institutions. The University of San Marcos in Lima is nearly 75 years older than Harvard. With beautiful and valuable collections made in the best spirit of the medieval Roman Catholic Church, and with the hospitality extended to us by our nearer neighbors, we have never needed to search these things only in Europe. Perhaps the colossal scale of Ecuador's physical geography is reflected in such values as these.

The fine old houses are mostly of Moorish and Spanish architecture. The principal exports are hides and forest products, with the weaving of the beautiful ponchos and working in silver, the main native crafts.

On a trip of this sort, everybody becomes a friend. These new friends were trying to keep me from going to Manta. The men said over and over: "It is primitive there. Wait in Quito. Let Doctor Murphy join you here."

"And waste his time!" said I. "There is only a bi-weekly plane. No, I am on the job of joining the Expedition and I must go."

Sr. Santos gave me a letter to his brother in Manta, which saved me enormous discomfort and was also the means of giving me a most wonderful time.

Our plane was late in starting. The flight down the mountains was cloudy. We landed at five, the men on the plane chagrined at leaving me on the stubbly airfield in a group of Indians. Instead of the usual tall North American boy, I found that even the Grace Agent in Manta is an Indian, speaking almost no English.

My last link with familiarity took off and I turned to my dark companions. They were nonplussed: strange women were not in the habit of flying into the airport of Manta, certainly not an unescorted gentle woman. We at once started on the long drive to Manta. The road was deeply gullied by tropical rains, as the rainy season had just ended. Instead of bridges, two logs a car's wheels apart were laid over each gully.

"Well," I thought, looking ahead at the first of these ramshackle makeshifts. "They value their lives as much as I value mine, so why worry?"

By that time we were over the first, and the rest were easy. I was soon seeing my first houses in Manta, which were made of split bamboo up on stilts, just like the houses in our childhood geography books. What surroundings for an almost totally deaf, non-Spanish-speaking grandmother! Driving off the road where a street had been washed out, we chugged through some shallow water and climbed back the other side to find ourselves on the waterfront mole. We stopped on a short piece of cement roadway, which must have felt as lonely and exotic as I did.

A gentleman speaking English came out to take my letter, saying he

▼ THE FIRST VIEW OF MANTA, one degree south of the equator on the coast of Ecuador, was not prepossessing. The house walls are nearly all of one thin layer of split palm or bamboo

▲ SEÑOR SANTOS with his pretty wife and nieces standing beside the truck in which the trip was made to Monte Cristi

▼ THE LITTLE TOWN of Manta practically flows into the sea, with canoes like these along the beaches

was Sr. Alfredo Santos. No man ever looked handsomer or kinder than did he,—after that ride!

"Mrs. Murphy, our home is full," he said. "Our nieces are visiting."

Warned that the hotel would be papered with newsprint and the plumbing incomplete, my eyes must have been beseeching, for he suddenly warmed and said:

"No matter, we will manage. Come to my home with me."

Señora Santos was out, and I would not, of course, touch my bags until her blessing was added to his. So ingrained is Latin American hospitality that no court-trained hostess could have outdone her thoughtfulness and courtesy. In thirteen years she had hardly been out of Manta and she spoke scarcely a word of English, but we found ways of our own to span the ill-doings of the Tower of Babel. The meals, which she herself superintended in the spotless kitchen, were delicious and were always fun, with all of us laughing.

Modern electric lights shine strangely through the split-bamboo house walls at night. The Santos home is made of stucco and is built on the hillside above the town, catching all the breezes. Behind the white picket fence and gate (only a yard high but always kept locked!) is the little garden and then the wide, welcoming door.

To quote from my notes: "As I write, waiting here for my husband's ship to come in, I am sitting at midday in the living-room section of the four-square, open-to-the-air first story of the pretty home. Outside the window, roses and dahlias and zinnias are in bloom, and through the dining-room door I can see a papaya tree bearing its chain of green fruit. It is no hotter than summer at home on Long Island. The climate here is much better than at Panama, and infinitely beyond the equatorial heat and heaviness of Buenaventura or Guayaquil, to the north and south of Manta.

"After 48 hours I am already part of the family life. Sr. Santos is the only man in town who speaks English easily. It is hard enough for me to hear English without delving into other tongues, yet my small list of Spanish words is growing. Angela and Inezita want to know how much everything costs in New York. In all of Manta there seems to be no English-Spanish book. Alfredo Jr., aged 12, has one with him in his boarding school in Quito. With that book gone, a high percentage of reading matter for foreigners has taken its departure.

"The house is airy, with very high ceilings and huge windows without screens. I have not seen one mosquito. Doubtless the steady breeze of this pleasant dry season blows them away, yet their imminence is proved by Inezita's bad malaria. The carabid beetles, which plump down like hail in all directions, are harmless. In the cool of the day, the family sits on the upstairs terrace, which is finished in bright-colored tile. The wide expanse of the Pacific so far offers no clue to the whereabouts of the Expedition's schooner 'Askoy.'

"I am the only North American at present in Manta, whose boasted 10,000 are nearly all Quechua Indians. The 23 foremost citizens have a Rotary Club, which is making things happen. The planes have just begun to come in. The exports of 'Panama' hats and tagua* are increasing. Through Rotary, the cement roadway is being extended, and the boiling of milk and water for drinking is encouraged. The Santos family would not touch an unboiled drop."

The most famous of the miscalled "Panama" hats are made in Monte Cristi and in Jipijapa, Ecuador. On

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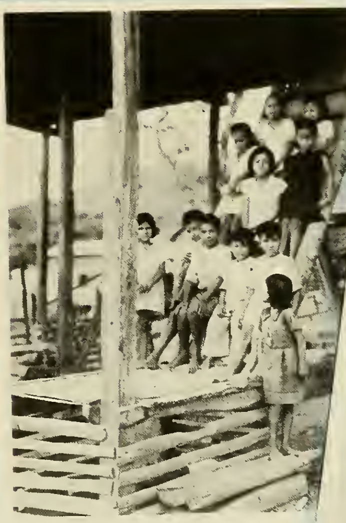
* The ivory nut, the seed of a South American palm, is used for turning and carving buttons, etc.

▲ A VIEW near the main street of Monte Cristi, where the finest hats in the world are woven. Note the flower-filled window boxes



↗THE VISITORS climbed up the "gangway" above into the house (at left) to watch a family weaving the famous "Panama" hats. These children learn early to weave belts and toys out of the same toquilla which goes into the hats

▼ THIS PARROT was offered the author for $8.00. When it was explained that United States law would not permit entry of a parrot through the Customs, the owner forgot his disappointment by being photographed

▲ THESE BOYS were full of fun and made the little donkey gallop faster than would seem possible

my first evening Sr. Santos informed me he had ordered a car to take us to Monte Cristi the next day to see them made. Recent rains had washed the road into a combination of ruts and holes that made it resemble a vibrating machine. The car was a truck with wooden seats, so we missed not a jolt, and clung on, laughing. Some of the holes we could leap across "full steam ahead;" others forced us to detour, searching out faint tracks through the lush growth. Halfway along, in the open country, we came on ⅛ of a mile of smooth asphalt, carefully laid for no apparent reason.

The tangle of tropic flowers, the great population of birds, and bamboo huts high on their stilts overlooking the scattered fields made every bump a thousand times worth-while. The few farmers grow maize and cotton, eating little else besides the corn. Here is no balanced diet. The hatmakers nearly all develop tuberculosis, and one prays for more power to Rotary and the introduction of modern nutrition. The scavenging of the vultures very likely cuts the toll of disease.

Indians passed us now and then, carrying loads up to 100 pounds on their heads. Some of them come into town to be house servants. Sr. Santos told me regretfully that they are paid next to nothing; that his wages to Angel, the house boy, are higher than most, being fifteen sucres, or one dollar a month. Angel works all the time, but as he is only fifteen, he is required during school sessions to go to school. He sleeps on a clean mat on the floor in an airy spot, far better off than were the servants I saw in Peru in 1924. He is well-fed and looks happy.

Monte Cristi runs up and down a hillside, and was charming in the brilliant sun—just a tiny village made of split bamboo, clean and neat and self-respecting, with bright flowers growing in tin cans along the glassless window ledges. The people are exploited by the fat hat dealer far more than I was supposed to know about. They are desperately poor.

We climbed the board runway to the height of the stilts into one of the houses, and were received by three or four generations of one family of hatmakers. Each person is assigned to a definite type and grade of weaving. Only by special privilege may the highest grade of hat be woven. That they are woven under water is a misconception; just the finger tips are frequently wet in a half-filled coconut shell. The weaver straddles a stool, leans his chest against a block, and bending over, reaches to another block on which is the hat. Fingers fly so fast one's eye cannot follow the strands.

The thought that "Askoy" might come in at any moment brought us back to Manta in the early afternoon. I was a little worried that Bob might miss me, not knowing about the grand way I was gadding. So I broadcast word in Manta that a reward would be given to the man or boy who raised "Askoy."

That afternoon we went swimming, and most of Manta went with us. As I struck out in my usual crawl stroke, I found myself a cynosure. Apparently no one knew the stroke. I proceeded to give a demonstration of the underwater out-breathing, and a few of the boys tried, but no one persisted. Rather a lark teaching the crawl to Ecuadorean Indians! Failing, I swam farther out, and a cry was raised, "Sharks!" There weren't any though; my host was merely worried at the idea of a lady in really deep water.

As we sat at lunch the next day, the extra houseman came running down from his watch on the terrace, eyes aglow, saying he had raised "Askoy!" How amazing that Bob out of the Pacific and I from New York should meet on the exact day of planning, down on the equator!

Sr. Santos and I walked to the dock. The ladies, of course, stayed at home as South American ladies do. Manta donned every available uniform. By the time the schooner had anchored in the roadstead, seventeen Ecuadorean officers and men were escorting me to her in the motor-tug of the Captain of the Port. The epaulets out-Gilberted Sullivan! Man-of-war birds with forked tails, made an air convoy. And my husband played up to the curious throng in true Hollywood greeting style.

It was wonderful to be on board and hear all the story, to see the work that had been done, and most of all to meet the six other men. The town swarmed out to the craft, and the Santos family came to tea.

The next day the Belgian mate and engineer and I went to the open market built along the beach front, where tame pelicans make convenient garbage cans. The two young men bought up all the available fruit and vegetables, but avoided the fly-covered fresh-killed meat. The curiosity of the people toward us alien folk was always quiet and unobtrusive.

Bob and I gave a dinner party to the Santos family that evening. Ecuadorean food is good. The table was beautifully arranged in the open courtyard of the hotel, under the acacia trees. Three of us spoke English, three Spanish, and two both. The long, intricate meal was delectable, the wines excellent. A tiered birthday cake, done in pink and green and decorated with flowering vines, stood in the center. Bob and Inezita—the tall scientist and the eager little girl, whose birthdays both fall in April—cut the cake together.

To quote again from my notes:

"Sunday, April 6. The effort of getting out notebook and pencil makes one wonder not that Ecuadoreans don't do more, but that they get so much done. If I stayed here, I would sit in a rocking chair under an acacia tree, as I am now, with a dozen smiling and quiet youngsters waiting to do my slightest bidding. One is holding a white hen lovingly in her arms. The hen is equally quiet and agreeable. It took four of these, not counting the hen, to get me a white bowl filled with fresh water to wash my face and hands in. Pink soap and a blue towel were set under a tree. Bob washed in it too, and noticed that the water was full of mosquito larvae.

"A boy is setting places for our *almuerzo* outdoors. Wrens and butterflies and flowers are around us, and one forgets the poverty and ghastly lack of sanitation. I tip the children ten cents Ecuadorean, less than one cent North American. I find out which is whose brother and sister, and they are courteous over my single-word method of speaking Spanish.

"The hen is still self-contained and polite in the pretty little Indian's arms. I believe she tried to sell her alive for our lunch. Not succeeding, she has tried to sell her to me. I don't know just what I am expected to do with a live hen. I have given her a coin, and now she and her little brother are gone. Here comes *almuerzo*!"

The seven delicious courses cost 21 cents. Our dinner party last night cost $10.00, including the wines and large cake. We understand we were fleeced.

Yesterday Bob quite took me off my feet by saying he wanted me to sail down the coast with him in "Askoy." Of course I had longed to, but had not expected to, for it was al-

▲ "Bob thought he was taking my picture, but I caught him and the Customs House of Manta"

➤ In the courtyard of the Hotel Buenos Aires, the scene of the party described in the article, a huge Galápagos tortoise was the children's playmate

ready crowded with seven men on board. Later he said to me, "I told the men you are coming."

"Oh, Bob, how wonderful! What did they say? I'm terrified at what they said!"

"Well," teased my husband, "first they fainted, then they swore."

They gave me a royal welcome! Commander Fallon, the Colombian Officer sent on the Expedition by his Government, moved out of Bob's cabin and bunked in the dining saloon. Under such circumstances he did pretty well to ask me to stay until June! The Belgian boys, Oscar and Robert, shaved their beards, apparently in my honor. José Correia, who makes the most beautiful birdskins in the world in the fastest time, could not get over the fact that he and Bob and I had sailed together on the brig "Daisy," in the Caribbean in 1912, and were all three here on "Askoy" in the Pacific in 1941. The old skipper, Captain Connolly, was gracious in letting me take the wheel, and Doctor Armstrong put up with my keen interest in the scientific attainments of the trip.

There were porpoises and fish and birds, and the food was rough but good. Once I slipped out to sleep on a bench under an umbrella to escape some of the closed-in heat of the tropical rain. The fun and laughter and the seriousness, and the sun dropping into the Pacific at night, with all hands at ease to watch it, combined to make the two-day sail a magic thing.

Late Tuesday we reached Salinas, the new watering place of Guayaquil, where Spanish pieces of eight are still picked up now and then. The red tape over our one-night anchorage took long to untangle and cost a lot, but "Askoy" needed supplies.

As I had no reservations home, not knowing ahead when I would leave, the agent was properly shocked that I wanted to travel by the early morning plane. Bob and I had talked of my waiting over, but my job was done, and it was right to hurry back and tell my tale to the kind powers at the Museum.

As I walked out of the plane at Quito, a familiar arm waved and the older Santos brother rushed forward: "Come on, Mrs. Murphy, I am going to the equator."

"Oh, but is there time?" I asked, "I am taking the plane to Cali."

"I'll get you back—come on!"

An American engineer and I were the passengers in the car. We passed through little mountain towns of warm, thick-walled adobe houses. Sr. Santos stopped at one and beckoned me to the porch, where a whole family were weaving rope out of sisal. The mother was nursing a baby bandaged from head to toe in tight swaddling clothes. The only part of that child to move were the lips. Sr. Santos said.

"She has borne sixteen, and buried eleven."

And my heart longed for a district nurse to teach her the way to keep her children.

We soon saw the monument that was put up by the Ecuadorean Government on the exact line of the equator in memory of the French scientists who determined the line.

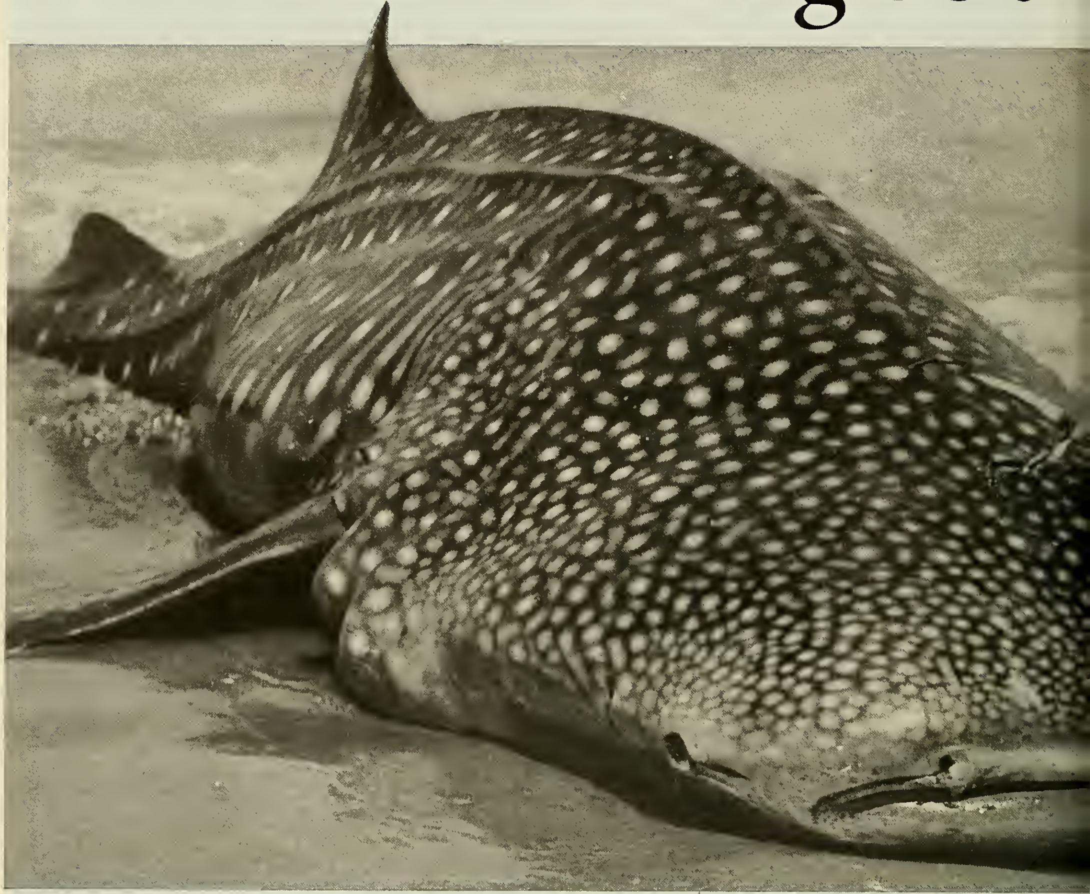
I got out of the car and, standing with one foot and half of me in the Northern Hemisphere and the other foot and the other half of me in the Southern Hemisphere, looked down the long valley to the everlasting and glistening snow of the great Cotapaxi, 19,500 feet above sea level, a gorgeous, icebound inconsistency standing guard beside the equator. Three days later I was in New York, the whole experience an unreal reality, in my memory for all time.

▲ Angela and Inez on the waterfront with Dr. Robert Cushman Murphy

➤ Heavy mourning is prescribed for the women for long periods. The expedition's ship "Askoy" is in the middle distance. The pelicans are keeping the beach clean

▲ The writer in two hemispheres at once! Latitude 00° 00′ 00″ in Ecuador

The Largest



in the World

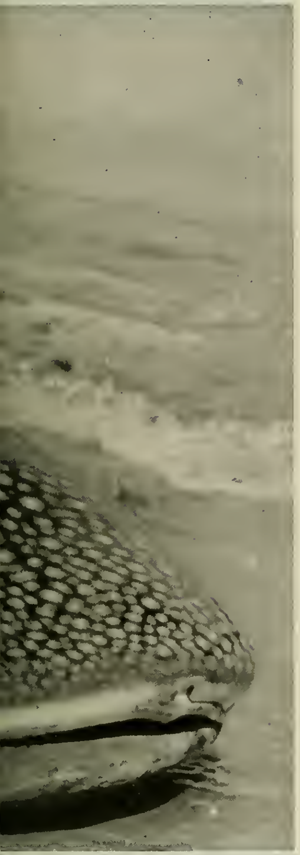
ONCE SEEN, the world's largest species of fish is easily recognized by its wide mouth, light spots, and parallel ridges extending toward the tail

THE GILLS of the Whale Shark are more important in feeding than are the teeth, which are only ⅛ inch long and useless for biting. As the water strains

THE Whale Shark (*Rhineodon typus*) is the largest living fish. This specimen recently caught off the coast of Peru is almost the only recorded specimen for that part of the world.

The Whale Shark is estimated to reach a weight of 25,000 pounds and a length of 60 feet. It is harmless and has no known enemies. It puts up no fight when captured by man; and strange as it may seem, the teeth of the world's largest giant among fishes are only ⅛ inch long and useless for biting. The Whale Shark feeds on

Fish



hrough the gills, small organ- sms and sardines are filtered out and swallowed to give the great animal nourishment

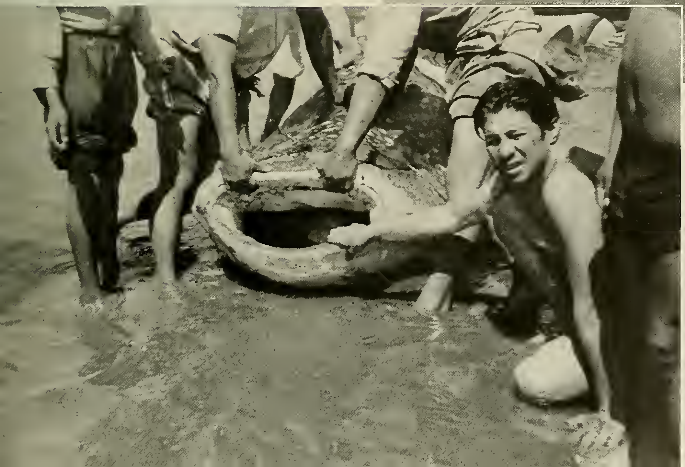
small organisms and sardines filtered out of the water by its gill rakers.

This specimen, apparently a young one, is about the same size as the mounted Whale Shark which can be seen in the American Museum's Hall of Fishes. The photographs of it were taken by Dick Norris, representative of the International Game Fish Association for Peru. The only other record concerns a specimen taken off Callao 65 years ago and examined by Prof. William Nation, who described it in the *South Pacific Times* of Callao for July 24, 1878.

The specimen shown was harpooned for its liver, in a district where war conditions have given impetus to the quest for fish as food. The other views, showing the locality, were taken by the American Museum expeditions sponsored by Michael Lerner in 1940 and 1941.

Cabo Blanco, where the Whale Shark was captured, is near the westernmost point of South America. Burros and vultures are a common sight near the native fish market on the beach. The balsa raft, with sail hoisted, has just come through the surf

The type of raft on which the natives brought in the Whale Shark is here loaded with a different kind of shark



A man could almost slide into the mouth of even this young specimen, but the ponderous Whale Shark wouldn't think of attacking and comes in without a struggle

Nine-Day Wonde

By HOBART E. STOCKING

The story of one of North Americ
greatest natural disasters, with a popul
explanation of how and why hurrican
roar up out of the breathless doldru
one to twenty times each year to destr
what lies in their path

Photograph by Brown Brothers

WRECKAGE caused by the famous Galveston hurricane of 1900

SEPTEMBER 7th, 1900, was a clear day in Galveston, Texas, a type for which the city is famous. A constant breeze from the Gulf pushed back the continental heat and brought comfort to inhabitants of the Island. Only Mr. Cline, the weatherman, as a part of his routine duty noted the high cirrus clouds moving from the southeast.

Water front life moved in its usual bustle throughout the morning. The afternoon arrival of a heavy swell from the southeast caused only a minor flurry among deck hands and dock workers as they shifted hawsers under strident voices of deck officers who sought a firmer bond with land. The waning sun gave way to darkness, and Galveston settled to rest in the ceaseless roar of breaking swells.

By five o'clock the following morning the city was awake to comment on the abnormal tide. In spite of a gentle breeze off the land, the sea perversely rose into lower portions of the city. Some were not only awake but were busily engaged in rescuing stores from salt water. Over all boomed the roar of surf, thundering persistently on the south shore of the Island at intervals of from one to five minutes. There was an ominous overtone in the monotony.

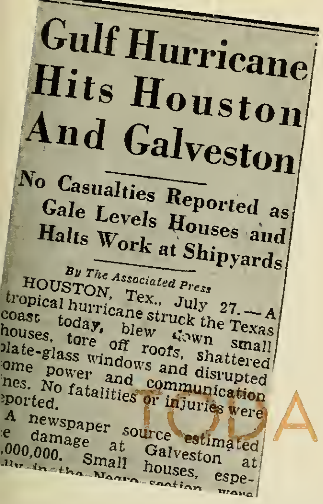
Somewhere in the doldrums west of the Cape Verde Islands, sometime during the preceding week, the sun beat down on a calm ocean. Heat waves rolled over the oily surface, and from it rose enormous volumes of heated air, saturated with ocean vapor. The air rose gently at first, for its buoyancy was slight. As each molecule mounted, another moved in from the side to replace it; the motion was moderate but on a vast scale. The earth's rotation imparted a spin to the currents, and as the warmed air spiraled to higher levels of lower pressure it expanded. With expansion came cooling; with cooling came precipitation; from precipitation came latent heat to rewarm the air and quicken the movement. Light airs flowing gently over the surface of the ocean became a breeze, increased to a wind, mounted to a full gale, rotating counterclockwise. Thus a hurricane was born.

Caught in gentle Westerly Trades, the newborn monster—offspring of tropical calm, torrid heat, and ocean moisture—moved ten to thirty miles an hour, west and north. Lean and voracious at birth, it fattened on each northward mile, eventually to gain a diameter of destruction 300 to 600 miles in extent. Each league northward increased the earth's rotational effect on the storm path, deflecting the disturbance from west through north, toward the east.

It whirled south of Santo Domingo, cut northward to rip across western Cuba. It might have followed the path of its predecessors up the Atlantic coast, but a wall of high barometric pressure to the north proved an insurmountable barrier. Thwarted on the Gulf side of the Florida Peninsula, the hurricane moved west, almost parallel to the Gulf Coast.

South of the Mississippi Delta the tempest reached full maturity. Shaped like a cosmic phonograph record—hundreds of miles across but merely thousands of feet thick—the maelstrom of screaming winds whirled at 120 miles an hour. At the ocean surface winds spun at steadily increasing velocity toward the center of the storm. Near the vortex the centrifugal force of their rotation restrained them from closing in, and displaced by a following mass of air, they mounted vertically. At the vortex—the "eye" of the storm—there remained a circle of incredible calm of sunshine on raging waves. And there, for the first time in hours, a captain on the bridge might see as far as the length of his ship.

But this was no haven of peace. Within the eight- or ten-mile circle of sunshine the confused ocean writhed from the torture of wild winds and torrential rain which, for the moment,



Gulf Hurricane Hits Houston And Galveston

No Casualties Reported as Gale Levels Houses and Halts Work at Shipyards

By The Associated Press

HOUSTON, Tex., July 27.—A tropical hurricane struck the Texas coast today, blew down small houses, tore off roofs, shattered plate-glass windows and disrupted some power and communication nes. No fatalities or injuries were eported.

A newspaper source estimated e damage at Galveston at ,000,000. Small houses, espe-

TODAY

had passed on. On land the "eye" would be a breathless interlude between chaos and confusion, for the arrival of the windless vortex marks the passage of only half of a hurricane.

Moving westward across the Gulf of Mexico, the roaring spiral held up a mound of ocean ten to twenty feet high in the eye of the storm. Each day of its life the hurricane lifted two billion tons of vapor from the ocean and each day poured back the same weight; torrential rain fell an inch an hour. At lower levels there was no boundary between air and water. Hurled by gusts mounting to 140 miles an hour, the mixture of spindrift and rain struck with the bruising impact of flung gravel.

Winds raged with maximum violence in the front, right-quarter of the storm where forward movement of the mass augmented wind velocity. Air in the opposite sector, retarded by the same forward movement, moved at lower speeds, from 90 to 110 miles an hour.

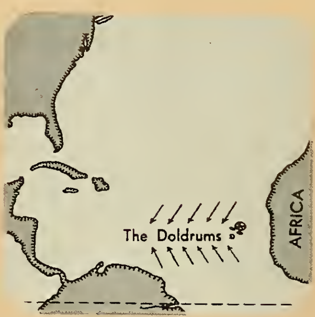
Vicious air heaved the ocean into gigantic windrows that moved with the speed of wind. Greatest confusion reigned in the following half of the hurricane for here waters buffeted first by winds from the right of the storm path were suddenly struck by shrieking gales from the left. Contorted by wave motions from divergent directions, the ocean leaped and fell in mobile hysteria. Pyramidal waves sank as abruptly as they had risen, leaving vast holes bounded by leaping masses of sea.

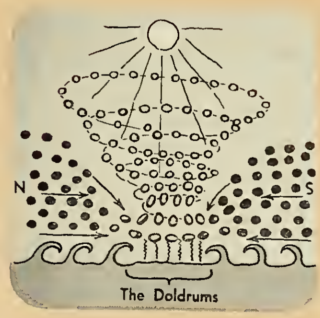
At the front of the tempest, titanic waves, moving with irresistible momentum, escaped the grasp of the storm and fled from its fury. Moving

Growth of a Hurricane

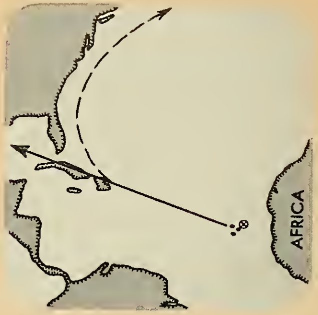
Drawings by G. Miles Conrad

➤ SOMEWHERE IN THE DOLDRUMS west of Cape Verde Islands lies an area of weak and variable winds. Here the notorious Galveston hurricane of 1900 had its beginning. Arrows indicate the prevalent trade winds

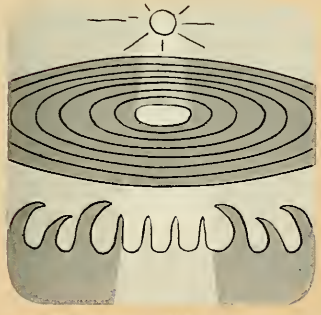




◂ ABOVE THE HOT SEA, molecules of heated air rose in a column, and other molecules leapt in from the sides to take their place. The column expanded at upper levels, forming a sort of cone

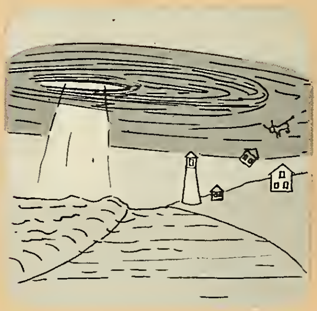


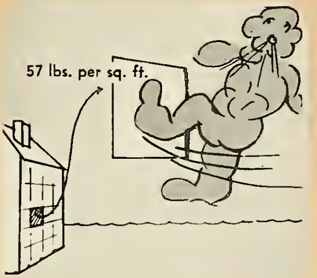
➤ MOST TROPICAL HURRICANES in the North Atlantic follow the broken line, but the famous Galveston hurricane met a barrier of high atmospheric pressure in the region of Florida and was prevented from curving northward here



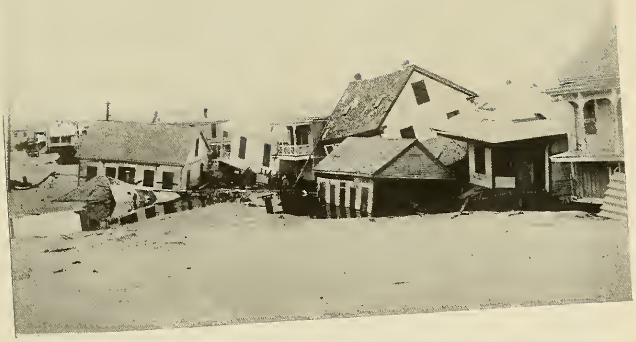
◂ WESTWARD THE STORM GATHERED STRENGTH and took the form of a huge whirling disk. At the vortex an opening, resulting from the centrifugal force of the spinning, permitted the sun to shine through upon seas tossing tempestuously beneath relatively still air

➤ THE ROARING SPIRAL held up a mound of ocean ten to twenty feet high in the center or "eye" of the storm. Each day it lifted two billion tons of vapor from the ocean and each day poured back the same amount in torrential rains




57 lbs. per sq. ft.

◂ UNDER THE IMPACT OF THE CYCLONIC WIND each square foot of exposed surface in Galveston received a kick of 57 pounds. Mountainous waves were picked up and flung against the city, and destruction advanced street by street



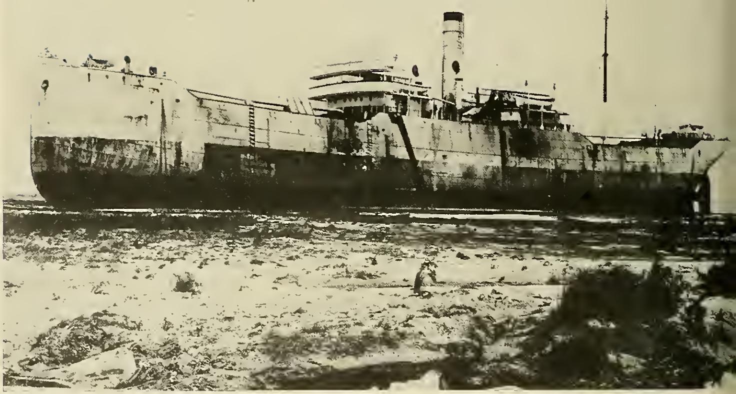
sunken in sand

◄ THE RESULT OF A "WEATHER BLITZ:" houses unseated and sunken in the sand by the Galveston hurricane of August, 1915

U. S. Weather Bureau photographs

▼ UNWILLINGLY "DRYDOCKED:" a steamer washed inland by the 1915 Galveston hurricane

washed ashore



into regions of light airs and calm seas, they were reduced in height and, widened into broad swells. Traversing five, four, three, two hundred miles, they thundered a warning on the shores of the Gulf. When the hurricane struck Galveston, the city had prepared for the attack as best it could.

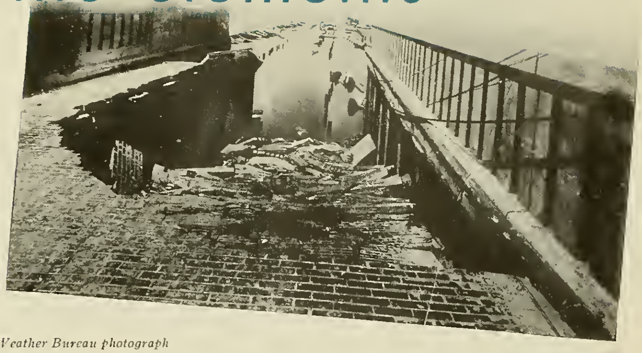
Rain fell on beleaguered Galveston in the morning of the 8th, and from that time on there was no relief from the deluge. The winds shifted from north toward east, and with each degree of shift they gained in force and velocity. Inhabitants living near the beach sought safety in the center of the city, and those already there chose the strongest shelters available. By three o'clock in the afternoon Gulf waters lay three to four feet deep on the city, and thereafter people moved from shelter only under threat of imminent death. A full gale howled through the streets, ripping off a roof here and there and using it to batter down walls to the leeward. Coastal folk, accustomed to the might of storm waves on the beach, now hovered in terror as the waves battered their homes to kindling.

Mr. Cline, the United States weather observer, stood in the doorway of his home, which rested on an elevation fifteen feet above tide. On the second floor were his family and 50 other terrified citizens vainly seeking a haven. Faithful to his duties even at this moment, he made mental notes of the catastrophic phenomena about him. Even as he watched, there was a sudden surge that lifted and held the water more than waist-deep.

At eight P.M. there was a moment's pause as the east edge of the vortex passed over Galveston. Having dealt destruction with a colossal right hand, the tyrant in an instant rained blows on the island city with an equally deadly left. Striking abruptly with a force of 57 pounds on each square foot, hurricane winds grasped waves already mountainous and flung them against the city. Destruction advanced street by street, creating battering rams as it leveled houses and with these weapons devastated each succeeding row.

At eight-thirty Mr. Cline's home disintegrated, and most of the refugees within, including his wife, sank from sight. Struck by a flying timber he lost consciousness, but later recovered to find himself clinging to his youngest child. Cline, three of his children, and his brother clung desperately to floating wreckage. Later they pulled a child and a woman from the raging waters. For three hours they moved with the storm, climbing from raft to raft, dodging flying timbers, sighting neither house nor inhabitant. It was by freak of fortune and storm that these terrified beings

invasion by the elements



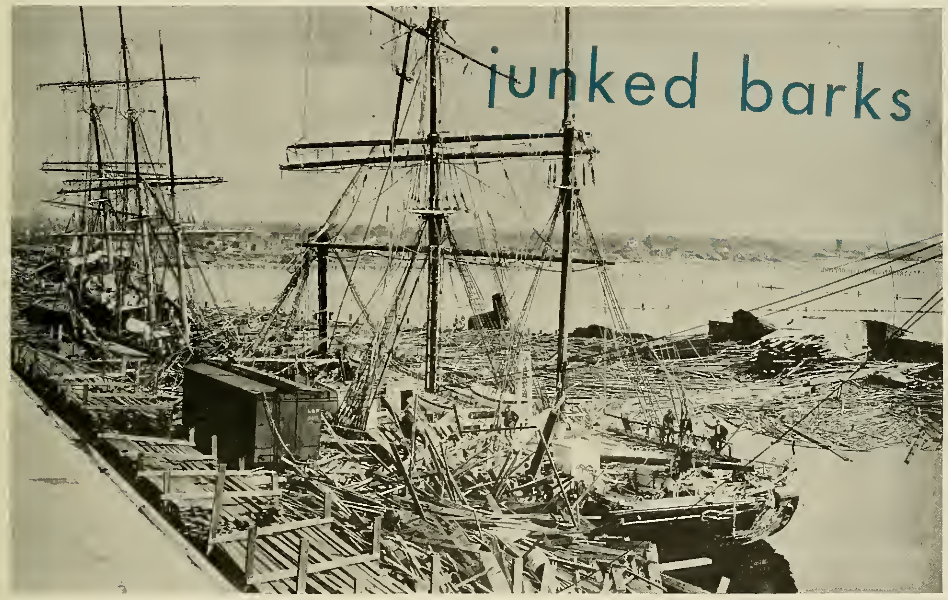
➤ THE GALVESTON CAUSEWAY, destroyed by the hurricane of August 17, 1915

U. S. Weather Bureau photograph

▼ PENSACOLA, FLORIDA, was struck by a hurricane on September 27, 1906, which caused this damage at the foot of Commendencia Street. One of the two barks shown had to be sold for $50.00

U. S. Weather Bureau photograph

junked barks



ended their journey not 300 yards from where it began, as their refuge of the moment grounded in subsiding waters.

Six thousand people suffered Mrs. Cline's fate; 3600 houses were totally destroyed and not a structure in the city escaped serious damage.

The hurricane roared northward across Texas toward the trough of low pressure. Deprived of its nourishing vapor, the tempest weakened, but swinging sharply northeast it sucked new life from fresh waters and littered Michigan beaches with debris. It crossed the valley of the St. Lawrence and moved out over the North Atlantic.

There was everything tragic but nothing unusual in the Galveston hurricane of 1900. Even the path which led it to the Texas coast was not unique. The city had heard the roar of big winds before, and confident that this was not the last, Galveston fortified itself with a sea wall which has since withstood similar attacks.

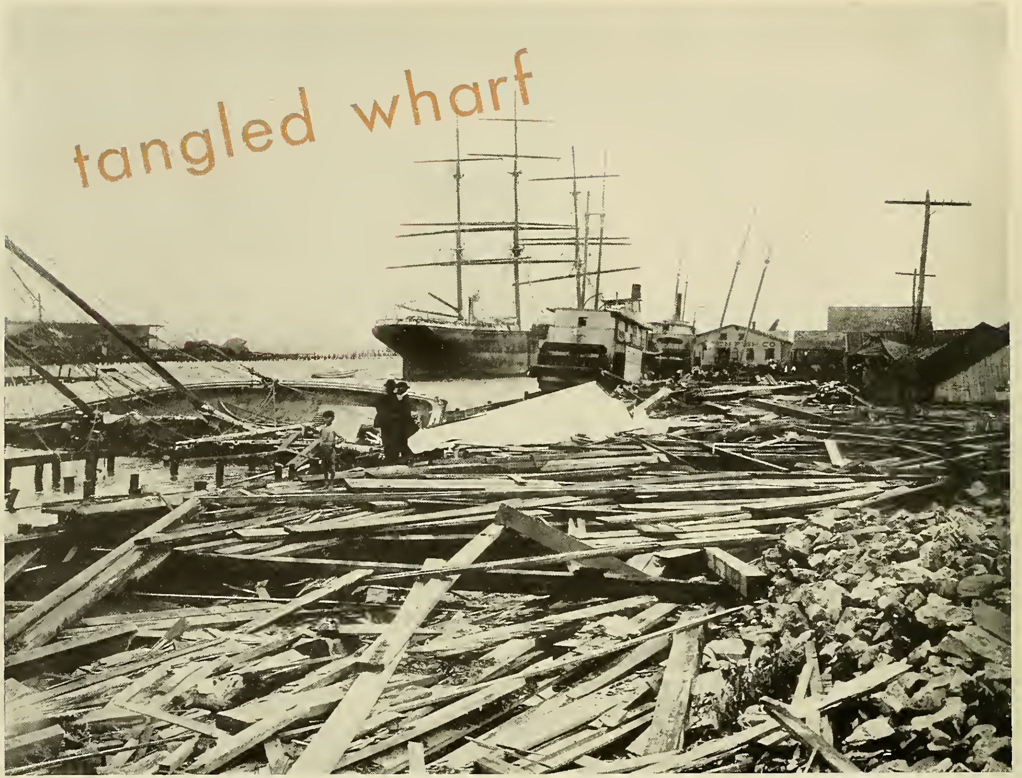
There is nothing new in hurricanes. Columbus heard of the "big wind" from the Carib Indians who called it *Hunrakan*, after their god of stormy weather. Before Columbus and since, one to twenty times each year, sometimes thrice in a single week, hurricanes have roared out of the doldrums into upper latitudes. They have terrific energy, and their average life covers nine days of destruction.

In Jamaica there is a jingle which warns the inhabitants when to expect the big winds:

June too soon,
July stand by;
August look out you must,
September remember,
October, all over.

But just as June is not always too soon, neither do hurricanes always avoid Jamaica in October.

Spaniards of Colonial times were aware of seasonal variations in hurricane paths. The Church decreed that *"Ad repellendat tempestates"* be included in all masses recited in Puerto Rico during August and September but not in October, whereas the same appeal was ordered in Cuban devo-



U. S. Weather Bureau photograph

▲ **The Pensacola hurricane** of September 27, 1906, showing the wreckage at the Baylen Street wharf

tions during September and October.

Mighty tropical winds are not limited to the Caribbean; they are a common offspring of areas of calm the world over. The Chinese *tai-fun* (big wind), the Philippine *baguios,* the Australian willy-willy, the Bay of Bengal typhoon are all hurricanes under another name. In the Northern Hemisphere these storms always revolve counterclockwise and move first northwest, later swinging northeast. Their cousins in the Southern Hemisphere rotate clockwise, moving first southwest, later recurving southeast.

That there is less loss of life from hurricanes in the twentieth century than before is due largely to the astuteness of Willis L. Moore, onetime Chief of the Weather Bureau. At the outset of the Spanish-American War, Moore took a long view through history and saw that more armadas had been destroyed by weather than by the enemy. He placed the facts before President McKinley in graphic form, who, after he had examined the evidence, stated to Moore: "I am more afraid of a West Indian hurricane than the entire Spanish Navy. Get this [hurricane warning] service inaugurated at the earliest possible moment . . ." Today no convoy leaves the United States Coast, east or west, without full knowledge and careful consideration of the weather to be encountered.

Hurricanes have changed the course of history more than once. A south Pacific typhoon that struck Apia, Samoa, in 1889 blew away a war then brewing between the United States and Germany. The United States was resentful when Germany, pushed by Bismarck, captured the native ruler of Samoa and set up a Quisling—a prelude to complete confiscation of the island. The natives rebelled, and Germany declared war against them.

German warships shelled helpless native villages and destroyed American property in complete abandonment. Very shortly three American warships confronted as many German men-of-war in Apia harbor, and the matter came quickly to the verge of actual combat.

At this moment a typhoon roared down the bottle-neck of the harbor and, despite all anchors and full steam into the wind, sank the six vessels. Forgiving Polynesians rescued American and German sailors alike at the risk of their own lives. Lacking ships with which to carry on the dispute, the matter was submitted to negotiation and the freedom of Samoa was guaranteed for many years by the Treaty of Berlin in 1889.

There was one innocent bystander who escaped harm and taught a lesson. At the height of the storm, the force of the wind against the bare masts and yards of the American and German warships was greater than the strength of their feeble engines and they were unable even to hold to their anchorage. But the British warship "Calliope," one of the earliest designed to move by strong engines alone rather than by sail and steam.

steamed out of the harbor into the teeth of the typhoon and reached the safety of the open sea.

This accomplishment opened the eyes of our Navy Department to the advantages of stronger engines and fewer sails on men-of-war, and the sunken vessels were replaced with ships adequately powered. The present American Navy is a monument to the sailors lost at Apia, Samoa, on March 16, 1889. Thus did a big wind in the South Pacific leave its imprint on the course of history.

stranded birds

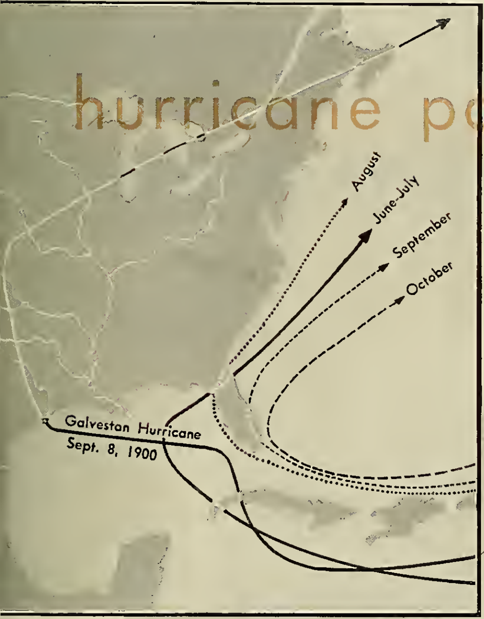
➤ LAND BIRDS are sometimes blown far out to sea by hurricanes and forced to take refuge on any passing ship as shown here

U. S. Weather Bureau photograph

hurricane paths

➤ THIS MAP SHOWS THE AVERAGE PATH of all hurricanes in each of the months of the season. The route of the Galveston storm was but a moderate deviation from the normal September path. It was unusual chiefly for its long journey over continental North America

Drawing by Hobart E. Stocking

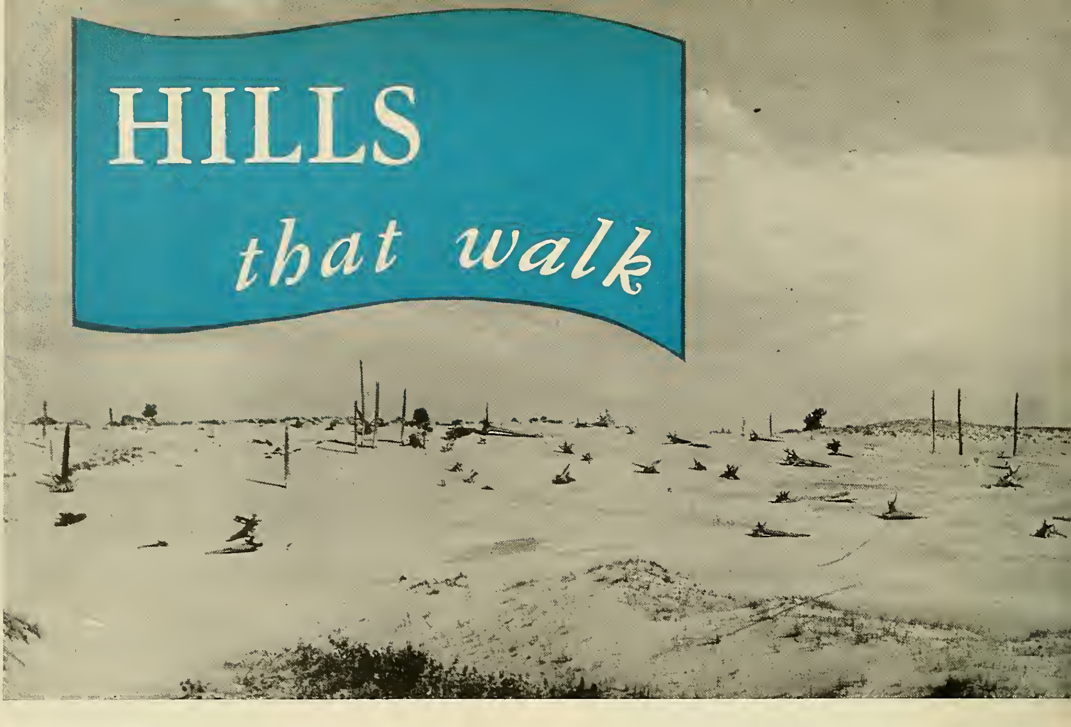


wrecked warship

➤ WHEN THREE GERMAN WARSHIPS shelled native villages in Samoa in 1889, three ships of the U. S. Navy confronted them. A war would have followed had not a typhoon roared in and sunk all six vessels, one of which was the German "Adler" shown here. As a result, stronger engines became the watchword of the United States Navy, and our present fleet is a memorial to the sailors lost in that storm. Most hurricanes enjoy a destructive life of about nine days. But this storm influenced history for decades

Official U. S. Navy photograph

HILLS *that walk*



Root and drifting sand fight an unending war on one of Nature's strangest battlefields, a miniature Sahara only 50 miles from America's second largest city

▲ Ghost forest. The only sound of battle was the whisper of wind-blown sand, but the devastation in this section of the Indiana Dunes is nearly complete

By Edwin Way Teale

All photographs by the author

From the spot where I am sitting, beside a clump of parched marram grass, the sand slants away for an eighth of a mile. It forms a vast amphitheater, hollowed out by the winds and piercing the long chain of the Indiana dunes. Under the August sunset its tawny flank has a coppery hue. Noiselessly, a thin white line of distant waves creeps onto the shore out of the blue of Lake Michigan.

From time to time a breath of air carries the freshness of the lake up the arid slope. It sets the quartz grains rubbing together in a thin dry complaint and pushes its way through the plumes of the parched grass with a hissing murmur. Those two small sounds—the lisp of the running sand and the rustle of the sparse vegetation—are, like the cannonading of armies, the sounds of a deadly conflict. They are opposing forces made vocal on one of Nature's strangest battlegrounds.

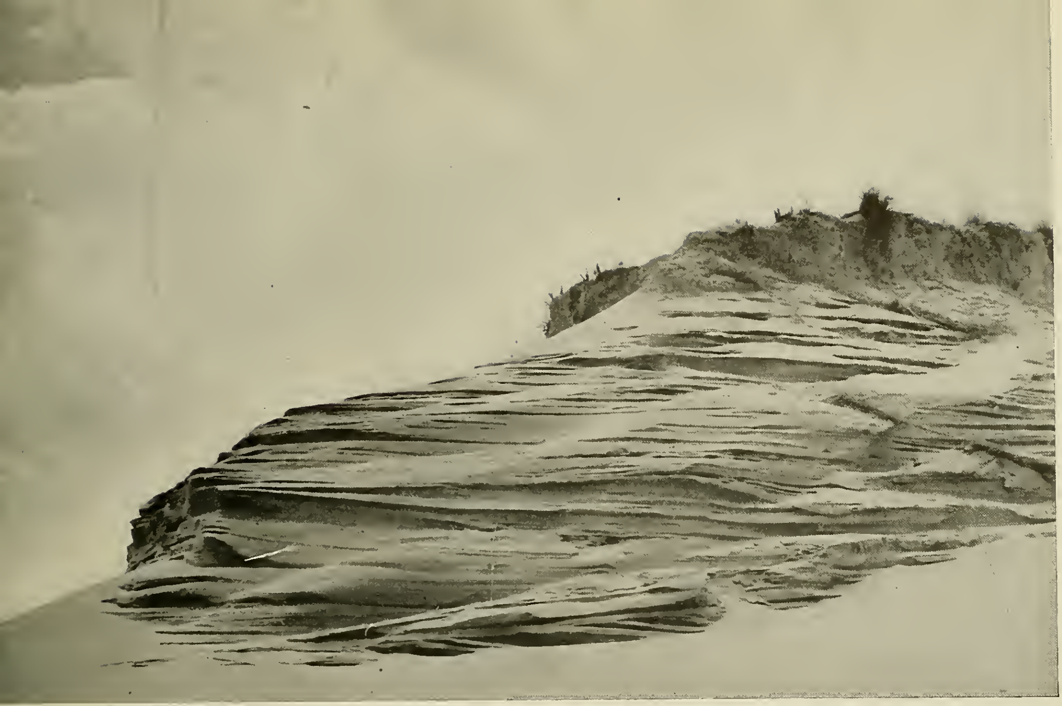
For nearly four decades, first as a farm boy on the outskirts of the Dune Country and later as a frequent visitor drawn again and again to this area of endless struggle, I have watched the changing tide of battle, the eternal tug of war between the vegetation—seeking to anchor down the sand—and the wind—seeking to carry it away.

In one place the vegetation wins, and a wandering dune becomes stationary, carpeted with green. In another place it is the wind that triumphs, and the yellow sandhills—"hills that walk"—continue to move forward ponderously year after year, engulfing plants and bushes and even great trees that lie in the path of their advance.

This battle has continued since the glacial period, when bluffs on the western shore of Lake Michigan were eroded by the waves. Currents, set up by the prevailing winds from the northwest, are said to have carried the debris to the southeastern tip of the lake. There the action of ice and wave forced the sand out onto the shore. Accumulating in great dunes, it created the crescent of hills which borders the lake's southeastern tip. Literally thousands of these dunes, many of them higher than an eight-story building, range along sections of the Indiana shore and run northward up the Michigan side of the lake. The highest of the Indiana dunes is Mt. Tom, near Waverly Beach. Its crest is 190 feet above the waters of Lake Michigan, and its base covers an area of more than 100 acres.

Viewed from an air liner, the dunes have the appearance of a curving string of green and golden beads. Seen from the motor highway to the south, they look like a row of stooping giants, facing toward the east. For, as a rule, the prevailing wind shapes the dunes so that the longer slope is toward the west and the more abrupt descent toward the east. The dunes themselves, as well as the great blowouts and the small ribbed patterns on the beach sand, are autographs of the wind.

To anyone interested in the world of Nature, this battlefield of wind and root has particular attraction. Birds heading up and down the great Mississippi flyway make it a stopping point. Rare plants await the botanist in sheltered gullies and moist "pannies" among the dunes. Written in grains of quartz, the story of the region is of absorbing interest to the geologist. Its zones of life, its curious



▲ **A HILL FORMED by the wind is now being destroyed by the wind. The cover of grass clings tenaciously, but the tide of battle has turned**

inhabitants, its instances of adaptation to an unusual environment, its ecology—all are engrossing to the student of natural history.

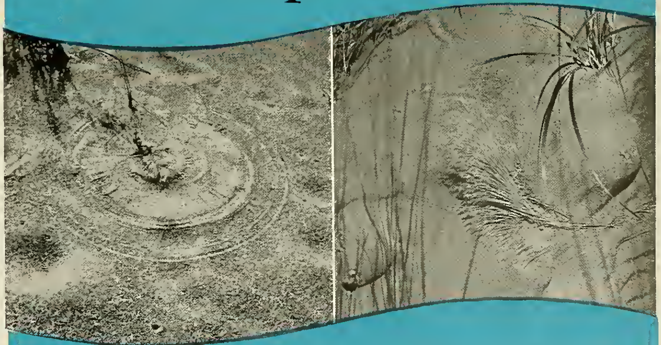
In this region, Dr. H. C. Cowles, of the University of Chicago, spent years studying the struggle between vegetation and moving sand. His scientific reports are classics in the field of botany. Victor Shelford studied the life of this region as the basis for his work on *Animal Communities in Temperate America.* Donald Culross Peattie compiled a whole book on the flora of the dunes for The Field Museum of Natural History, in Chicago. And H. G. Wells, in his *The Science of Life,* devotes space to the ceaseless struggle which continues there for life in many forms.

Even after the turn of the century, this crescent of dunes, guarded on the north by the waters of Lake Michigan and on the south by a wide belt of swamps, remained a stronghold of Nature. Although it lay hardly more than 50 miles from America's second largest city and less than two miles north of the tracks of the main line between Chicago and New York, hunters in my boyhood used to tell of hearing the howl of wolves among the snowclad dunes on winter evenings.

Few roads bridged the belt of marshland in the region of my grandfather's farm, and those that did were formed of rows of parallel logs placed on the uncertain footing of the bog. As our wagons rolled over these "corduroy" roads on expeditions to the lake, I used to watch with fascination the earthquake our passing produced. Water in the ditches beside these makeshift highways would quiver, and plants growing on the opposite banks would tremble as though in a breeze.

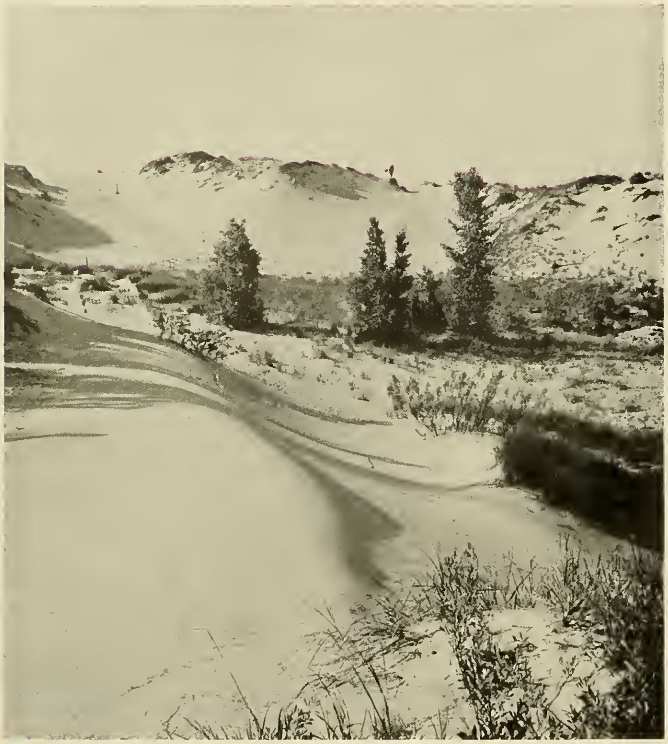
Arriving among the dunes themselves, we found surprises all around us—just as surprises await the visitor today. Cacti, very like species found along the Rio Grande, put forth their cream-colored flowers. Little lizards with blue tails and yellow stripes darted among the fallen leaves. Tiger beetles, their metallic-hued bodies shining in the sun, raced along the

wind patterns



Blades of grass, blown by the wind, trace beautiful designs

story in sand



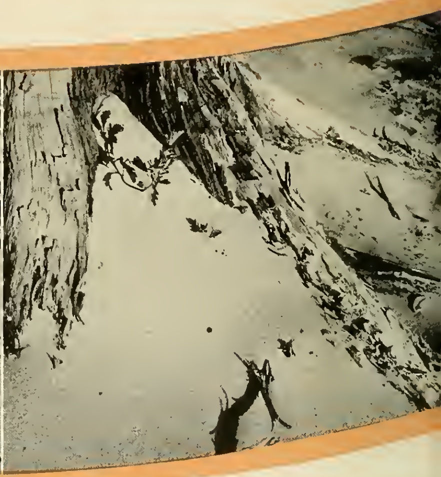
hot sands and cardinals, bluebirds, goldfinches, and ruby-throated hummingbirds nested in the sheltered valleys.

Because of the widely varied types of habitat available here, bird life has always been abundant in the dunes. In the spring, when the birds came up the Mississippi flyway and fanned out over the Great Lakes region—and again in autumn when they funneled back into the same skyroad to the South—I used to see soaring hawks and a multitude of small migrants passing by. Occasionally I would see snow geese and blue geese. It was my habit to climb the long slope of the farmhouse roof and, astride the ridge, spend hours watching birds now perhaps completely gone from the region—bald eagles and sand-hill cranes—wing their way above my head to disappear among the yellow hills to the north. Whooping cranes, long before my time, were abundant migrants there, and great flocks of passenger pigeons used to settle down among the dune land trees.

Even today birds seem to be everywhere. Piping plover and spotted sandpipers dart along the wet beach. Black terns and herring gulls skim above the waves. Bank swallows have their nests in the sides of the blowouts, and orioles feed on the edge of the open glades. South of the line of dunes, the great blue heron, the coot,

"Knee-deep" in sand, a thriving tree still produces rich verdure though the battle for survival is hopeless. The scene at top is a typical "blowout," with young vegetation

Looking like snow in the noonday glare but offering temperatures well over 100° F., the invading dunes climb higher about the ill-fated trunks



In time the trunks, alternately buried and exposed, are barkless. An infant plant tries to grow in the protecting fork of the roots, but cannot and the bittern—as well as the raccoon and the opossum—dwell in the swamps and hunt along the banks of slow brown streams. Few, if any, other sites of similar size in North America have as wide a range of plant and animal life as does the crescent of Indiana dunes.

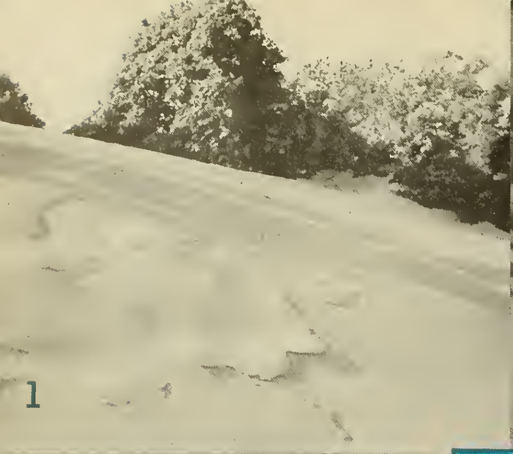
More than 300 different species of herbaceous plants and shrubs make this area their home. Trailing arbutus, leading the annual parade of the flowers, often comes so early in spring that it blooms by the edge of a snowdrift. By May there are great carpets of blue and yellow—lupine, marsh marigold, dogtooth violet. As the season advances, there are rare orchids in the swamps, where pitcher plants and sundew also dwell. Even on the Sahara of a dunetop, where the sand reaches a temperature of more than 120° F. at noonday, I have sometimes come upon a stalk of common milkweed, rooted and growing, sprung amazingly from some far-drifting seed.

Each zone of life—from the singing sands of the beach, through the reed grass and sand cherries of the dune-edge, through the pines and cottonwoods of the dune-flank, through the ridgetops and blowouts, through the oak and maple and basswood of the sheltered ravines, and on to the lush swamps and tamarack bogs beyond—each of these zones of life has its individuality and its unique inhabitants. Isolated plant communities develop in the deeper ravines. Species ordinarily found far north or far south of the region grow side by side. A wild rose with thirteen petals which, so far as is known, grows nowhere else on earth dwells in two small communities among the dunes. The flora of the region ranges from the most primitive plants to the most complex of later species. As one botanist puts it: In a day's walk among these sand hills, you can trace virtually the whole history of 20 million years of plant development.

Fortunately, in 1925, the state of Indiana obtained a 2,200-acre tract in the heart of the dunes between Gary and Michigan City. This Indiana Dunes State Park extends from west of Waverly Beach to east of Paradise Valley, beyond the Big Blowout. While concrete highways have brought hundreds of thousands of visitors to the area and while Waverly Beach, at the far western end of the park, has become a summer playground for vacationists from Chicago and Gary, the whole eastern section of the park remains virtually as it was.

There, the work of the wind goes on. The swamps to the south are still untamed. Wild ravines await the tramper who leaves the beaten path, and large sections of the dunes are no different today than they were 25, or 50, or 100 years ago. An excellent hotel at Waverly Beach, nine marked trails, and nature guides who know

Shorn of leaves and branches, the tree above will someday topple over to lie among the other fallen giants. One of these is shown to the right, its roots jutting defiantly into the air. Wind and weather wear exposed surfaces into curious forms (upper right). Finally the whole tree is reduced to a humble vestige of its former glory (right)



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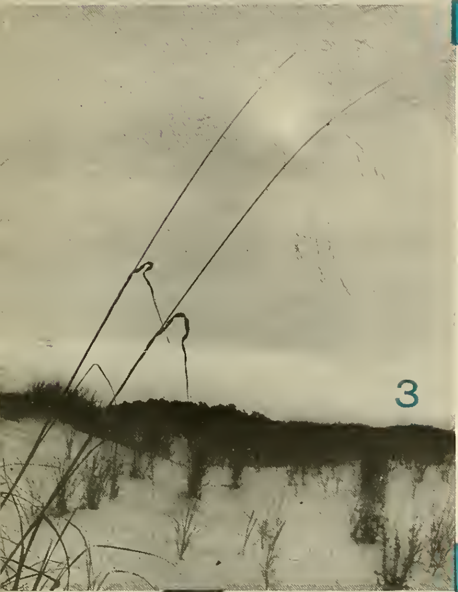


3

studies in destruction

1 Curious patterns are made by the wind in the drifting sand of the "hills that walk"

2 Vistas through the twisted roots and branches of fallen trees provide interesting compositions for the photographic explorer

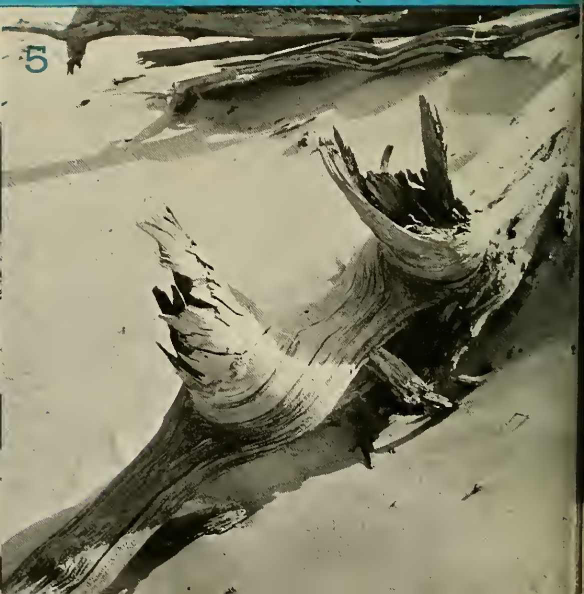
3 Through an overcast sky the sun throws a weird light over the lonely scene. Despite the severity of the struggle, more than 300 species of herbaceous plants and shrubs make the dune area their home. In the marshy areas dwell rare orchids, pitcher plants, and other interesting flowers

4 Roots are exposed when a change in the cycle undermines a tree that was once buried alive

5 The texture of timber polished by the winds offers an infinite variety of camera studies in light and shadow

6 The sands have killed the growth that barred its advance, but Nature leaves a masterpiece of sculpture to commemorate the struggle

4



5

6

the area thoroughly are of assistance to the visitor who wishes to explore the natural wonders of the park.

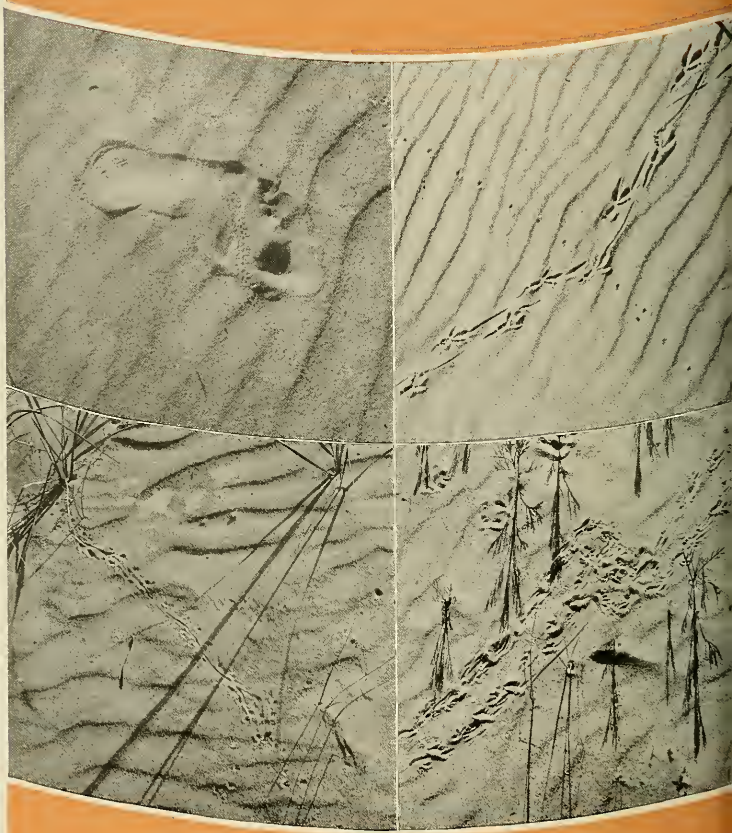
One of the strangest of these wonders is the vast "ghost forest" which rises from the floor of the Big Blowout. At some remote time a wandering dune engulfed a stand of great pine trees. Preserved by their resin, their trunks had remained buried for no one knows how many decades. Then stormwinds out of the northwest, raging along the dunes, had gradually cut a gap in the chain of sand hills. The gales of succeeding years opened it up like a fan. In a yellow avalanche, sand grains poured over the far edge of the blowout into the swamp. And, in the wake of this moving sand, the buried forest rose into view.

It now lies scattered over the wide amphitheater of sand stretching away from the spot where I am sitting. Some of the gaunt trunks rise, seamed and weathered, to a height of 60 feet. Others sprawl like fallen giants on the floor of the blowout. Where stumps are tilted on their sides, the twisted roots are seemingly stilled in the midst of action. This is a scene that I have surveyed many times, at all hours of the day and under varying conditions of the year. It is most strange and impressive of all at twilight, at such a moment as this when the luminous summer sky is tarnishing minute by minute and the silence of dusk deepens swiftly. Then the dunes—like great darkening waves in a sea of sand—seem most wild and lonely, most timeless and desolate.

The thought occurs again and again that here everything is as it might have been centuries ago. Then a sweeping arm of white light passes across the heavens overhead. It is the beam of a great revolving beacon, starting its night's work of guiding twentieth century ships of the sky to the landing field at Chicago. One of these air liners passes high above the dunes, the sound of its motors a faint throb and its red and green riding lights, barely visible, moving among the stars.

Curiously enough, these solitary dunes were the scene of pioneer researches that helped make possible this plane rushing at three miles a minute through the dusk. It was among these sand hills that Octave Chanute, the engineer who built the first bridge across the Missouri River and for whom Chanute, Kansas, was named, experimented with man-carrying gliders during the last years of the nineteenth century. His researches provided the groundwork for the Wright brothers. A few weeks before their successful conquest of the air, Chanute visited them at their camp among those other dunes on the North Carolina coast at Kitty Hawk.

footprints



A BIPED superimposed probably by the six-footed track of a beetle

A TWO-LEGGER with feathers: a cro crosses the path of a slowly moving weas

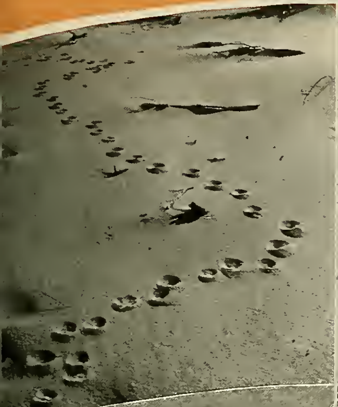
A FOUR-FOOTED ANIMAL close to the ground; probably a ground squirrel

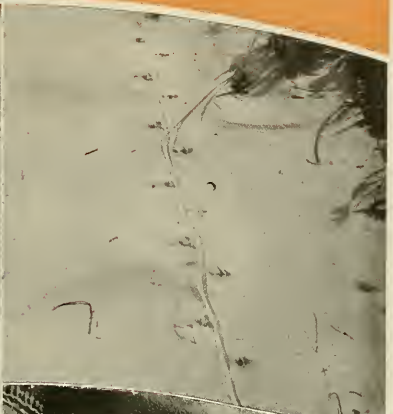
WHERE TWO LEISURELY SKUNKS probab pawed at the hole of a ground spid

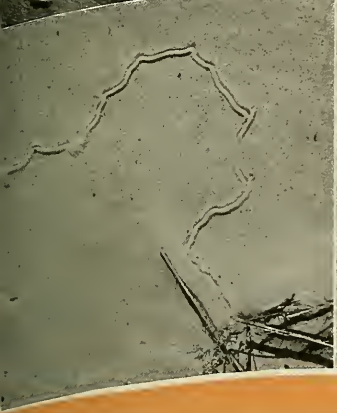
As a child, I heard echoes of the thunder of ridicule which rose about Chanute's head when the countryfolk of the region learned of his fantastic purpose in coming to the dunes. Most often the great engineer was referred to as "The Crazy Man of the Sand Hills." Yet, now, over these very hills, the throbbing engines of a metal sky liner symbolize success beyond his furthest dreams.

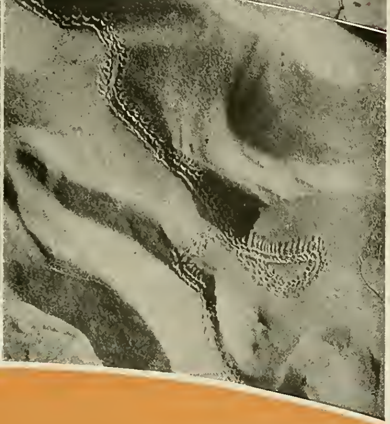
Long before Chanute, great events and the lives of other great men were linked with the dunes. Father Marquette came to the region in 1675. The great La Salle skirted the dunes on the old Pottawatomie Trail when he began his 1,200-mile tramp to Montreal at the conclusion of an ill-fated expedition to the Illinois. Indians

n the sand


OUR PAWS—beyond that, who knows?


FOUR PAWS AND A TAIL—a muskrat


HERE a burrowing insect left its curious track in the smooth sand, showing many changes in direction


NEAR BY among miniature dunes is proof that the "worm" will turn, even if he is a thousand-legger

moved stealthily along the same trail before the Chicago Massacre. And Daniel Webster unloosed his oratory at the now-vanished port of City West, not far from the present site of Waverly Beach.

All these events, so important to man, affected the dunes themselves not at all. Nature's endless battle went on just the same. The history of the ghost forest continually repeats itself. Even now, along the forward edge of wandering dunes, bushes and trees are slowly disappearing beneath a resistless flood of quartz. Some of these trees have merely a few inches of the yellow tide washing about their roots; others have a dozen feet of their trunks covered; and still others are fighting against suffocation with only their topmost branches in the open air.

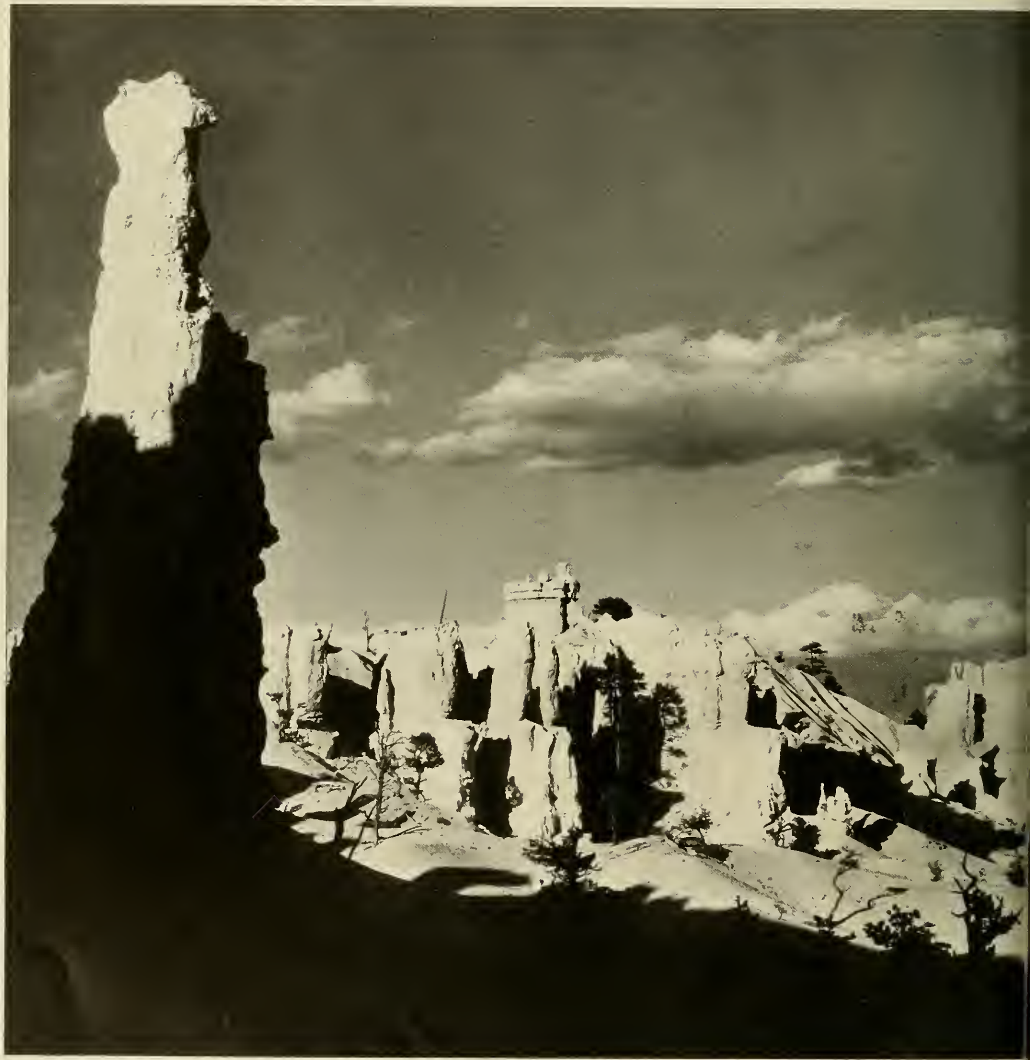
Along the steep, wind-cut sides of the blowouts, the trees are facing the opposite extreme. There the sand is slipping away from the grasp of their roots. There every breeze helps to undermine their precarious foothold. Like clutching hands, the gnarled roots, with roughened bark, cling to their unsubstantial support. Finally, the losing battle ends. Some gale or gust tears away the tree and it plunges into the valley of the blowout.

But everywhere throughout the dunes, roots are fighting to the very last. And when they lose, other roots take up the endless battle. Seeds, receiving moisture from melting snow and spring rains, push down their little rootlets into the inhospitable sand, and by some miracle a few become established as herbaceous plants or trees. Each is a green anchor to windward. Each acts as a brake on the flow of the sand grains. The swirl of the wind around them leaves its record in long ridges and webbed patterns on the sand. Little mounds of quartz rise around each rooted stem. But once the plant is established it clings tenaciously to its tiny foothold. It has set up a forward position in the land of the enemy.

Thus, through the years, the seesaw battle rages. It is a battle that never ends; a war without an armistice. "Hills that walk" and the varied vegetation that seeks to bind them down have combined to produce one of the most diversified and fascinating of Nature's strongholds.

➤ TUSSOCKS struggle against the wind, gaining here and losing there in the constant battle against the "hills that walk"

Wonderlands

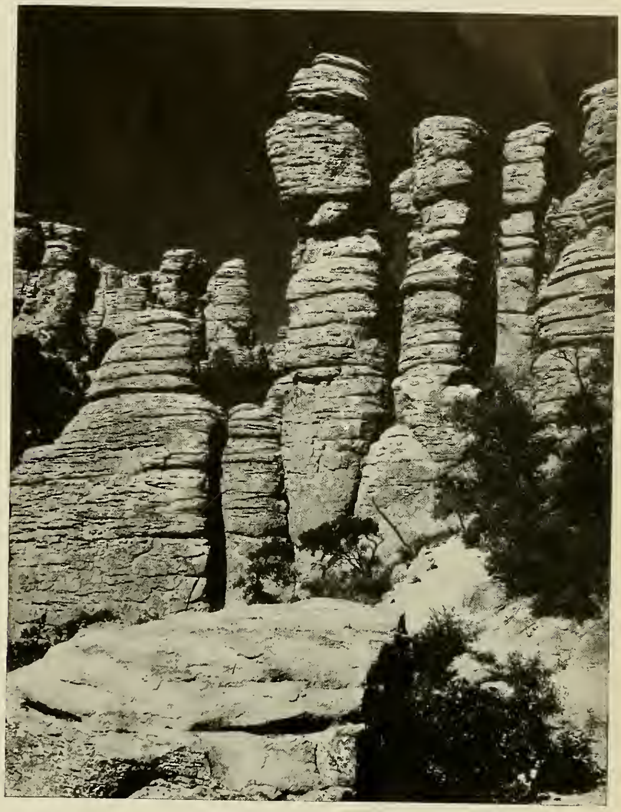


▲ THE SPLENDOR OF MORMON TEMPLE in southern Utah surpasses a master artist's most ambitious day dreams. When evening's black shadows leap out from the base of its polychrome towers, this gleaming pile becomes a dazzling miracle in frozen stone. Though desert rainfa is meager, cloudbursts and sudden streams carve the lan with vigor. Where scanty vegetation gives the drylan little protection, running water strips away yielding la

# of ROCK

By John L. Blackford

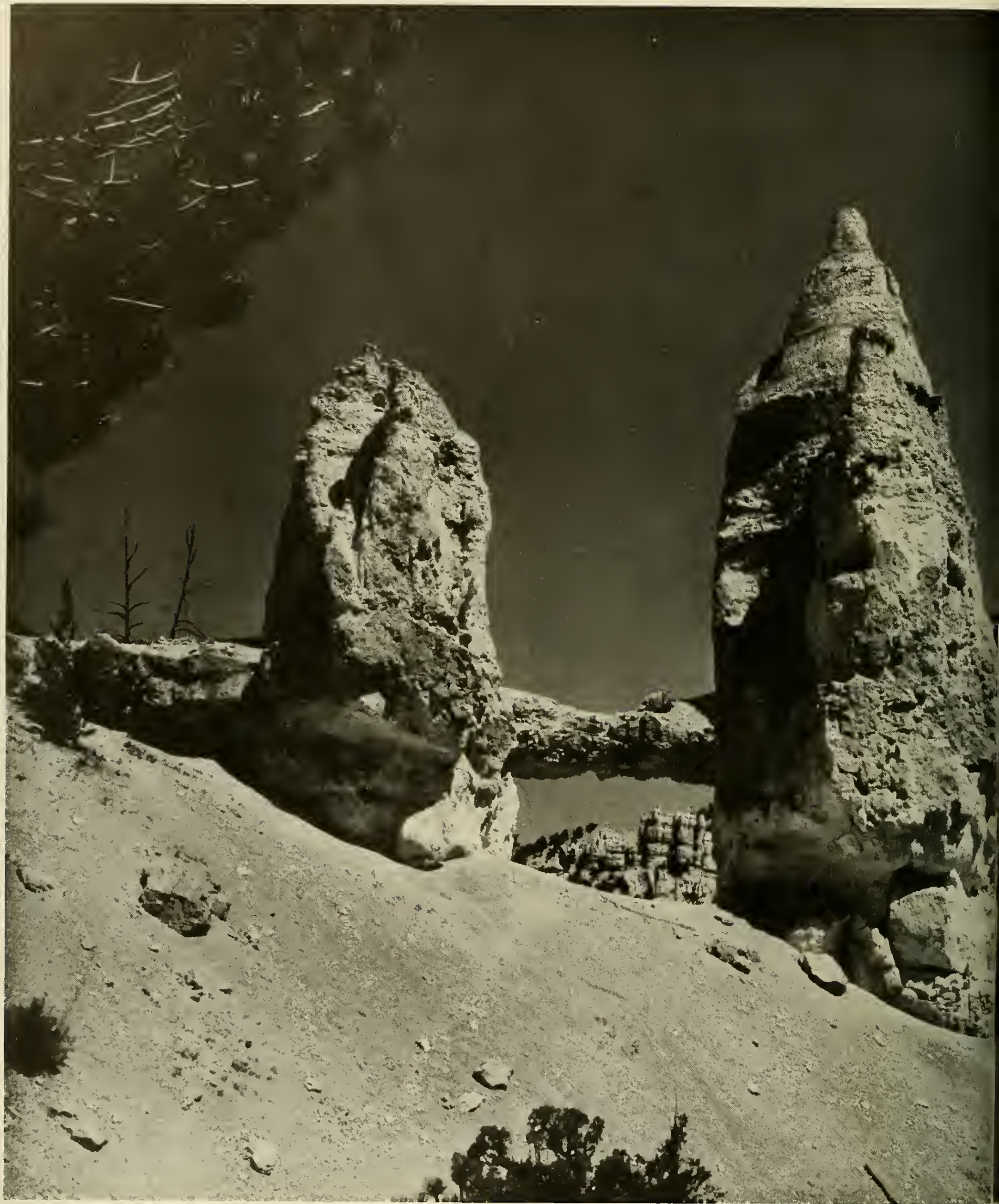
and dissects enormous plateaus.
ıdblown sand etches fantastic
res on the rugged canyon walls.
yce Canyon National Park)



▲ Bold, jagged, soaring columns and towers dominate Chiricahua National Monument in Arizona. Pedestal rocks, balanced boulders, and "hoodoos"—the latter often adorned with goblin faces—are the result of weather's attack upon vertically jointed formations. Horizontal irregularities have been developed by unequal attack on planes of varying resistance. Extremes in temperature sometimes cause the rocks to crack; then frost enters the picture, prying with irresistible fingers

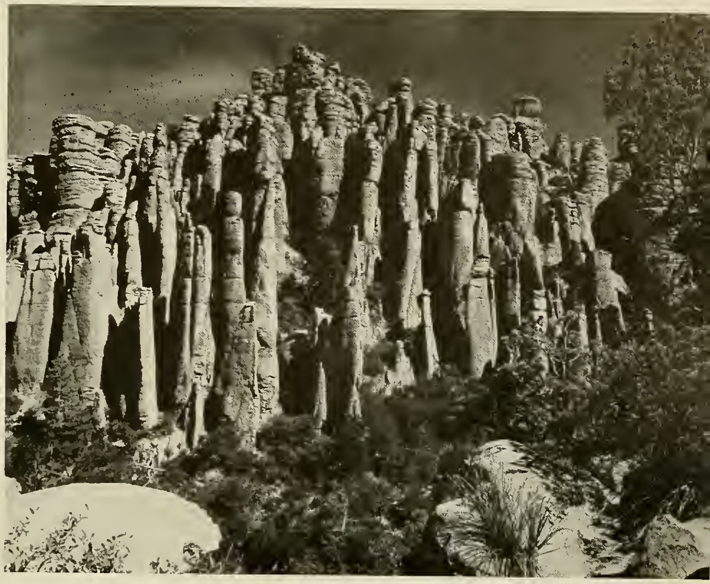
Fantastic castles, amazing canyons of gorgeous color, vast arches and rainbow bridges of stone, flaming mesas and marvelous monuments—these are some of Nature's miracles, wrought during long ages, in her wonderlands of rock throughout the Southwest.

In few regions of the globe have the processes of erosion and weathering, promoted by favorable climate, sculptured so many varied and instructive natural features. Weak and resistant rock layers, hardened muds and clays, dense volcanic outcroppings, and numerous types of surface topography have here lent themselves ideally to this massive and elemental landscape architecture.



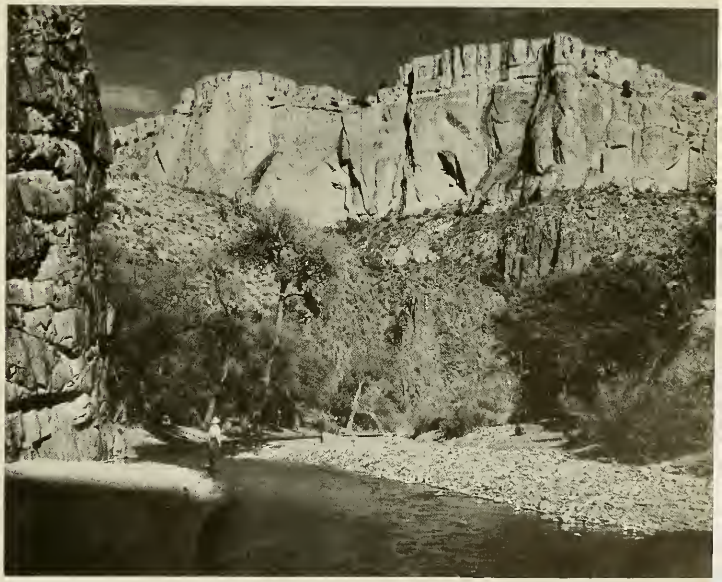
▲ TOWER BRIDGE, in Bryce Canyon National Park, is a striking example of the persistence of hard layers as softer beds are washed away. It is a seemingly contradictory rule in the effect of climate on landscape that where rainfall is scanty its power to sculpture the land is multiplied. I regions of heavy rainfall, thick vegetation protec the soil; in arid regions, the sparse vegetatio offers slight resistance to the scouring effect running water. Thus the rule that gives us som

r most spectacular scenery also provides an
rtant lesson in conservation. Where land is
for farming or grazing, sufficient growth
be maintained to hold the priceless soil
ace



▲ Hill of Spires: a hillside maze of colorful pinnacles typical of the Chiricahua wonderland. Unnumbered acres of similarly fantastic groups and figures, closely ranked, crowd the deep canyons and climb steeply to the ridge tops. Within their grotesque cloisters is concealed a botanist's paradise

▼ At one amazing bend of Aravaipa Creek bright, unbroken cliffs, like towering mesa walls, confront the eye. The inner slopes of this southern Arizona canyon are studded with the great spikes of the saguaro cactus. Below them is a paradise of bowered cottonwoods and rippling coolness



YOUR NEW BOOKS

MEDIEVAL AMERICAN ART • AFGHANISTAN • ANIMAL TRACKS

ANIMAL TRACKS

- - - - - - - by George F. Mason

William Morrow & Co., $1.50

ANIMAL tracks are always interesting and can convey considerable information to those initiated in their mysteries. And tracks can be present the year around, if one knows where to look. In winter, the snow supplies a fresh white sheet upon which the animals trace movements, escapes, tragedies; in summer, dust and mud afford an impressionable surface although they lack the continuity of the snowy expanse.

Articles and books have been written telling one how to identify the trackmakers and how to interpret their wanderings, but this literature is not extensive, and Mason's contribution is a real one. By well-executed line drawings and simple text, he has presented the subject admirably.

▲ Olmec Jade Pectoral, Mexico

➤ Recumbent Figure in Stone, Mexico

The list of animals treated ranges from big game—bear, deer, mountain lion, et cetera—down through mammals of medium size to include the smallest of all, typified by the shrew. Forty-four common North American mammals are sketched, footprinted, and described in a brief text which outlines the most salient points in their life histories.

The author has had experience with mammals, understands them, and has the happy faculty of delineating character in his sketches. His book will be useful and enjoyable to a large group of readers, for it can instruct the grownups and is understandable to children. It is a small book, a convenient pocket size, and does not run quite to one hundred pages. One should not be critical of the length, however, because the animals selected are adequately handled, and the price of the book is small too.

H. E. ANTHONY.

MEDIEVAL AMERICAN ART

- - - - - - - - - - - by Pal Kelemen

The Macmillan Co., $22.50

THE publication of *Medieval American Art* by Pal Kelemen is an event in the intellectual history of American Indian art. In two sumptuous volumes, one of text and the other of plates, the finest facets of aboriginal artistic genius are made available to a far wider public than they have hitherto known. The appearance of this substantial work is but one of an increasing number of signs that the art of the American Indian is being rescued from a long and undeserved neglect, a redress which *Medieval American Art* itself should do much to achieve.

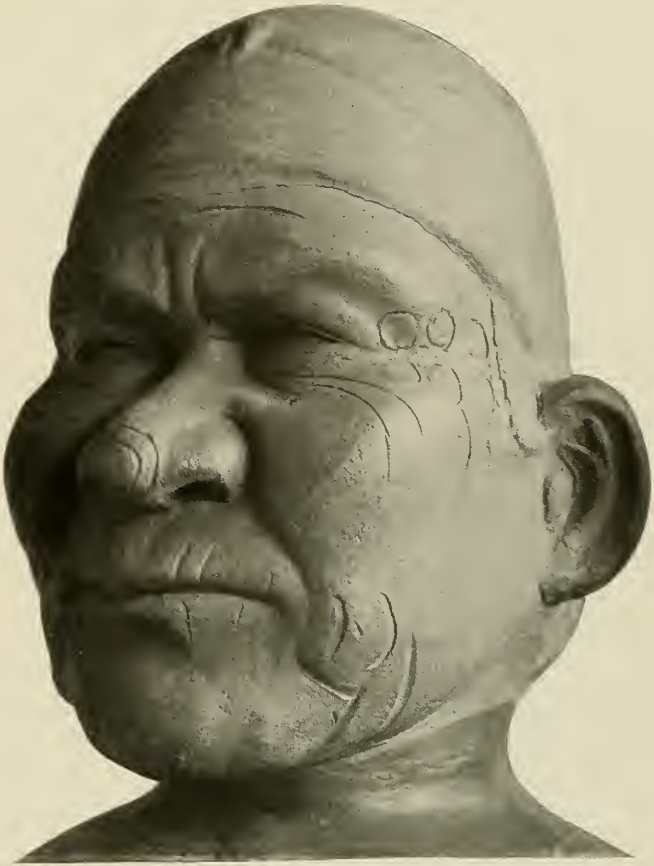
This is an appropriate moment in which to consider some general aspects of the arts that Dr. Kelemen brings to our attention. It is perhaps pertinent to enquire why it is that the art of the American Indian should have been overlooked in the past if it is indeed as significant an esthetic phenomenon as its enthusiasts claim. The answer lies in the evolution of the esthetic orientation of European culture. When Indian art first came to the notice of Europe, during the Renaissance, European culture was exceptionally active discovering its own potentialities and absorbed in exploring a vast range of intellectual and esthetic pursuits. If it consciously looked beyond its own sources, it was largely to classic antiquity. Indeed, the imprint of Greece and Rome upon its own inspiration left but little room in European culture for the admission of esthetic standards divergent from the established canons. Despite this intense, if parochial, attitude some few spirits did perceive merit in the exotic art of the Indians, but their sporadic appreciation failed to establish an enduring influence for it.

Moreover, art in Europe had become a highly individualized and personalized activity. The artist was no longer an anonymous craftsman as he had been in the Middle Ages. He was a significant personage who signed his work and expressed himself in a style deliberately his own. Art had lost its communal and folk character. It had become self-conscious and often as not served as the medium of expression for the artist.

The art of the American Indian, on the contrary, was anonymous. The artist worked deliberately in the common tradition and distinguished himself more by his superior skill than by any personalized expression. Such an art, given the circumstances, would seem to lack the importance that contemporary Europeans had learned to attribute to a signed and personalized art.

When Europe began to widen its perspective in the seventeenth and particularly the eighteenth centuries, it is interesting to note that it responded to such exotic arts as the Chinese, which in many ways possessed the sophistication and finish that seemed synonymous with fine arts. It was not until the nineteenth and twentieth centuries that Europe, somewhat jaded in its esthetic sensibilities, was prepared to receive and admire the strength, vigor, and imagination of less refined arts expressed in foreign idioms. Then it was that the admirable bravura of African art had its vogue, and it is only lately that the arts of the American Indian, treasured by a small group of connoisseurs, collectors, and archaeologists, have widened their appeal in academic as well as in more general circles.

It must be remembered in approaching the Indian arts that they developed in continental isolation, that they were produced by stone age tools, and that the religious and decorative traditions which lie back of them are difficult for us to under-



▲ A Portrait Vessel, Peru

◀ Twin Gold Alligators, Panama

stand. Much that seems crude and repulsive to our associations can be attributed to these factors. One has the natural tendency in contemplating the products of a strange tradition to pick out as excellent those examples that happen to conform to our accustomed standards most closely. Thus, the portrait pottery vessels of Peru are readily acceptable because of their straightforward realism. To rely too completely upon our standards in judging the art of the American Indian is to overlook the subtleties and the essence of native genius.

▲ Large Pottery Figure, Mexico

The adjoining illustrations were all selected from Doctor Kelemen's book, but they illustrate only a few of the many aspects of the subject. Doctor Kelemen has shown a catholic interest in American art, and includes in his treatment architecture, textiles, modeling, sculpture, carving, jewelry, etc. He confines himself largely to the area which centers in Middle America and extends on the south into Peru and on the north into the southern tier of the United States. Within these geographic limits a wide variety of tribes and cultures existed, each with a distinctive esthetic expression, but more important, this was the scene of the great civilizations and their influence. The various arts found here are depicted, described, and appraised. As the title of the volumes suggests, the time factor is pre-Colombian and for the most part contemporaneous with Medieval Europe. There is a pregnant comparison latent within the title which well deserves thought.

Medieval American Art is a monument to the art it signalizes. Its ample riches, its full documentation, and its breadth of treatment render it a source book for those who wish to explore this fascinating field.

H. L. SHAPIRO.

ARCHAEOLOGICAL STUDIES IN PERU, 1941-1942

- by W. Duncan Strong, Gordon R. Wiley and John M. Corbett

Columbia University Press, $3.75

IN spite of the vast amount of archaeological material that has been collected in Peru, our knowledge of the pre-Spanish history of that country is far from complete. From the contents of thousands of graves, from studies of ruined structures, and from historical data, various cultural sequences have been proposed by students of this fascinating subject. Too often the basis for conclusions has been theoretical, being only the result of personal impressions. This has not been due to the absence of concrete evidence but rather to the fact that the securing of such evidence involves a lot of unspectacular and at times physically unpleasant excavation. It is easy to understand the lack of appeal of work of this type, but until more of it is done many details of Peruvian prehistory will remain in doubt.

The present volume describes the results of the first serious effort along the central Peruvian coast to determine the chronology from stratigraphic studies of accumulated debris. In the course of one year of field work, excavations were made at Pachacamac, Ancón, Chancay, and Supe. Far more material was secured than could be described in the time available, so this report is largely confined to a discussion of the ceramic sequence.

The results corroborate and amplify some of the former conclusions on the prehistory of this area, and are especially significant in that they demonstrate an early succession of previously misinterpreted local ceramic styles. Additional evidence of what appears to be an ancient, widespread influence of the Chavin culture was secured, though its connection with the later cultures remains in doubt.

It is to be hoped that this demonstration of the sound value of systematic collection and analysis in contrast to former methods will stimulate the Peruvian archaeologists to similar endeavor.

JUNIUS BIRD.

TULSA; FROM CREEK TOWN TO OIL CAPITAL

- - - - - - - - by Angie Debo

University of Oklahoma Press, $1.50

MISS DEBO is the author of *The Rise and Fall of the Choctaw Republic, And Still the Waters Run,* and *The Road to Disappearance* (A History of the Creek Indians). Through these books she has become one of the best known historians of our Southern Indians.

Founded on the Arkansas River within the old Creek Indian Territory, Tulsa is emphatically a modern city with a dramatic history that could hardly have unfolded with such spirit and energy in any other part of the world. In 1836, the Creeks were removed from Alabama to the present site of Tulsa.

The Indians, destined to form the nucleus of modern Tulsa, came from Lochapoka, near the popular Creek Indian town of Tallasi. In this forced migration, they suffered the loss of nearly one-half their numbers. Miss Debo has given a vivid description of the founding of Tulsey Town, the dark days of the Civil War, and the rapid evolution of the industrial and cultural Tulsa.

The oil period had begun, and it was on the eve of statehood. Before a committee of the United States Senators investigating Tulsa Indian Affairs in 1906, Chitto Harjo, a full-blood Creek orator, spoke in a devastating manner. He quoted from a copy of the treaty with the white man, referring to the white man as "He."

"He told me," Harjo said, "that as long as the sun shone and the sky is up yonder these agreements will be kept . . . as long as the waters run it shall last; as long as grass grows it shall last. . . ." The senators, although moved by the Indian's desperate earnestness, tried to explain that this old treaty had been abrogated, and that it was hopeless to resist the changes that were taking place in the Indian Territory. The author says that this speech was the last flare of the Indian spirit in the white man's town of Tulsa.

TE ATA AND CLYDE FISHER.

THE GRASSHOPPER BOOK

------ by Wilfrid S. Bronson

Harcourt, Brace and Company,
New York, $1.75

THIS is a good book disguised in a poor jacket. It is for anyone from their "-teens" through their "-ties" who is interested in grasshoppers and their relatives. One is amazed at the amount of information about the life history and behavior of these insects, presented so clearly in so few pages. For the most part, the book is about the common grasshopper and its close kin, the katydids and crickets, although its distinct cousins, the roaches, walking sticks, and mantids are discussed briefly.

Mr. Bronson describes how the well-known short-feelered grasshoppers live and grow, and how they use their special equipment to jump, fly, fiddle, lay eggs, etc. His comparisons of insects to machines and his careful drawings make this explanation of how they work very vivid. He tells also of grasshopper plagues, of "locusts" used as food in various parts of the world, and of some of the different kinds of grasshoppers.

The chapters on the katydids and the crickets, the long-feelered relatives, are also extremely well-done. The sketches of them in action—washing, fiddling, dueling—are excellent and reveal the author-artist's sense of humor as well as his close observation. His accounts of the activities of his pets should make others want to observe and become better acquainted with these cheerful insect musicians.

It is not a juvenile book. In fact, *The Grasshopper Book* might well be recommended to some entomologists as an example of a readable and yet concise presentation of the subject.

A. L. B.

MEETING THE MAMMALS

------ by Victor H. Cahalane

The Macmillan Co., $1.75

MEETING THE MAMMALS is an attractive volume from the jacket to the conclusion. The reader has an able master of ceremonies in Mr. Cahalane, who introduces each mammal by entertaining text and well-executed drawings.

The author is in charge of the section on National Park Wildlife, and the 66 mammals he selects are inhabitants of one or more of the National Parks. They are the species of outstanding importance, the ones that a Park visitor will be most interested in knowing better. As a guide book to take into the Parks, this volume is well-nigh a "must" for the visitor, and it will be very useful also for any wildlife student whether he goes into the Parks or not. The data given can be verified most easily in the Parks for there the mammals are more tolerant of man, but with the knowledge gained by reading the book one can expect to get more out of wildlife contacts everywhere.

The introduction sketches in broad outline the scope of the book, the relations between mammals and park visitors, between predators and prey, and other fundamental topics. Then the author proceeds to a systematic treatment of species by species. He gives a brief description of the animal and its habits, and lists the Parks where it may be found. Each account has a pen and ink drawing done by Walter A. Weber, who has been successful in portraying character and graphic action.

The author has done very well in combining the precise information required for identification with the more readable and dramatic facts of life history, so that a wide range of readers will enjoy the book. It is not juvenile in any sense but it is a book that children can understand and use, that is, if the parents will give it up.

H. E. ANTHONY.

TRAVELS IN AFGHANISTAN, 1937-1938

-------- by Ernest F. Fox

The Macmillan Co., $4.00

THE remote mountain kingdom of Afghanistan was once the gateway through which rich caravans passed toward China, Persia, and India. Down through the reaches of history Aryans, the armies of Alexander of Macedon, and the hordes of Huns, Turks, Arabs, Mongols, and Persians passed through on their way to the wealth of India. Ghazni was once a great empire, and Herat the center of art and learning in all the Middle East.

In modern times, however, Afghanistan has been completely closed to foreigners, and it is only during recent years that it has been reopened to the western world. Few visitors have yet found their way there, and seldom have these strayed from the two motor roads which encircle the country.

Mr. Fox, as an American geologist engaged by the Afghan Government to explore for minerals, made his difficult way through remote regions entirely inaccessible to motor car and, as far as is known, never before viewed by European eyes. He is a practical man, and conjures up no fanciful adventures with robbers, as at least one popular writer has done. Mr. Fox found ample adventure in the problems of the weather, irresponsible servants, arduous mountain trails, and natives who declined any knowledge of mines in their neighborhood lest their solitude be invaded by alien industry.

One regrets that he did not take time to observe more fully the Tadjik, Hazara, and Afghan people among whom he traveled. Perhaps his haste was necessary, although there are instances when he seems impelled by sheer American desire for action and efficiency, in the face of the leisurely Afghan tempo. However, Mr. Fox writes well. His book makes interest-

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Above illustration—Nile River Group—Detail showing Antelope
Akeley African Hall—American Museum of Natural History

ing reading for the stay-at-home traveler and gives extremely useful information for the would-be voyager to Afghanistan.

Elizabeth Bacon.

MAN'S UNKNOWN ANCESTORS

- - - - by Raymond W. Murray

The Bruce Publishing Co., $3.50

THIS book will undoubtedly be welcomed by a great many people whose interest in man's past has been awakened by articles in newspapers and popular magazines, but who find these articles too sketchy and unsatisfactory. There are books enough in the same line as this from which they could get all the information they want, but many people hesitate to attack scientific literature and if they do, they are often discouraged by the many unfamiliar and unpronounceable words they encounter.

In this book they will find not only an answer to all their questions, in so far as the scientists have been able to give an answer, but they will find the explanation written in easy to understand language. The author has not tried to avoid the scientific terms, but in a special glossary he gives a clear explanation of the terminology and in another list the pronunciations.

The book is absolutely up-to-date. It tells about the latest discoveries and the effect they may have on the various standing theories. Hence the book is also useful to the student of anthropology who wants to follow the development in fields other than his own. The book is written primarily for Americans, so naturally the prehistory of the New World has been given a more detailed description than that of the Old World.

All through the book you feel that the author is trying to infect you with his own enthusiasm and love for his subject. He encourages you to visit the museums in order to see the finds, and he tells you how easy it is to get to the famous archaeological sites. If you are not already interested in the most fascinating of all stories—that of the origin and development of mankind—, you certainly will be after reading this book.

Helge Larsen.

SHELTER TREES IN WAR AND PEACE

- - - - - by Ephraim Porter Felt

Orange Judd Publishing Co., $2.50

FOR 30 years (1898-1928) Doctor Felt was state entomologist of New York. Since 1928 he has been director and chief entomologist of the Bartlett Tree Research Laboratories. For 27 years he was editor of the *Journal of Economic Entomology*. He is a leading authority on insect galls as well as on the insects and diseases of ornamental trees and shrubs.

This book has evidently been written because of the wholesale damage done to trees by the establishment of the large number of military and naval centers in United States, as well as by the tree conditions around industrial plants engaged in the war effort. Much of the tree loss could have been prevented if more time for planning had been available and if the fundamentals of tree growth were more generally understood.

The author says that future shelter trees are possibly more important than those of the immediate present. A war may be precipitated without notice, and growing trees give the best possible protection from enemy fliers. Shelter trees should be well located, and should have 20 to 50 years growth.

Among the chapters are those on Protection Afforded by Trees, Shelter Trees and Economics, Engineering and Trees, The Parts of a Tree, Essentials of Tree Growth, How a Tree Grows, Shelter Trees and War, Construction Work and Its Effect on Trees, General Care of Trees, and Selection of Shelter Trees.

Lists of trees recommended for various localities and conditions are given, such as, trees that tolerate smoke, trees adapted to the seaside, and for every section of the United States from South Florida to the Pacific Northwest. More than 50 illustrations add to the value of the book.

Clyde Fisher.

CHIMPANZEES: A LABORATORY COLONY

- - - - - - by Robert M. Yerkes

Yale University Press, $5.00

THIS volume is the work of one of the foremost comparative psychologists in the world, the man who founded and directed the Yale Laboratories of Primate Biology and is now their Honorary Director.

The first part of the book is concerned with the objective and physiological aspects of chimpanzee life. It takes the animals from the jungle to the laboratory and there acquaints one with the animals as individuals, showing their reactions to both ape and human contacts. The author also gives a study of their physiological life from infancy to age, and concludes with a contrasting objective study of the sexes.

Part II is devoted to the mentality of the chimpanzee. Experiments seem to prove that the animal can see the human range of colors but the ape responds more sensitively to the blue-green, or shortwave, end of the spectrum than to the yellow-red, or long-wave. His sense of hearing was found to be much wider in range than man's, and the animals are apparently capable of responding to high tones to which man is deaf. Concerning sensation, Professor Yerkes believes from his own observations that bodily injuries are less painful to apes than to man. However, so far as is known, the chimpanzee's world of sense impressions does not differ radically from man's.

Part III consists of practical instructions for the "Care and Handling" of the animals in the laboratory and will be valued by students of the subject, but it is not of so much general interest.

The book can be recommended wholeheartedly to all those who are interested in the evolution of animal behavior and the earlier stages of intelligence, as well as to those primarily interested in the chimpanzee.

H. C. Raven.

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CHIEF SEATTLE

- - - - by Eva Greenslit Anderson

The Caxton Printers, Ltd.,
Caldwell, Idaho, $4.00

THE Suquampsh Indian chief, after whom Seattle, Washington, was named, provides a good subject for a biography, and the American spirit of the author is revealed when she reminds the reader that Seattle was to become "the largest city in the world named for any Indian chieftain."

The book is copiously documented, and the appendix of nearly 50 closely printed pages makes it evident that a prodigious amount of research has preceded the writing of the story. These notes and bibliography alone constitute a valuable contribution to the early Indian and pioneer history of the Northwest.

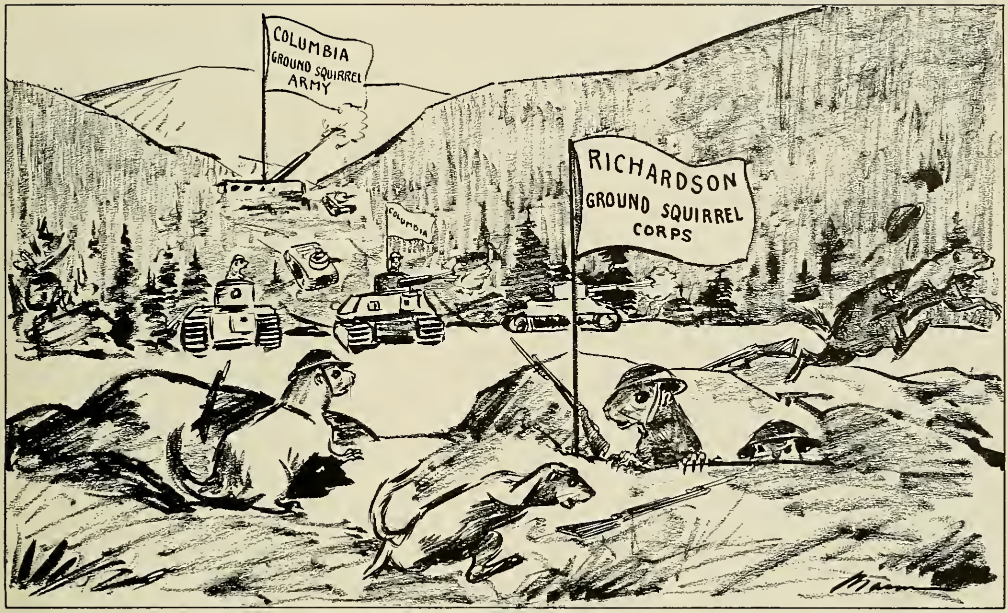
The biography is full of the usual record of the breaking of treaties and other promises by the whites. In spite of the greediness of the early settlers in cheating the Indians out of their best land and fishing places, Chief Seattle, it seems, always remained friendly and loyal to these invaders. Had he at the zenith of his power joined the hostile members of his and the neighboring tribes, it is probable that the British might have fixed the Columbia River as the international boundary line.

There is an interesting description of the building of the great potlatch house, known as the Old Man House, near the present town of Suquamish across Puget Sound from Seattle. This structure, the author says, "was thirty times as large as the potlatch houses of the Iroquois." There is also a vivid description of the gambling games of the Indians.

On the whole, however, the writing is disappointing. It lacks imagination, and the historical details seem to have gotten in the way. It is mechanical and obvious. The author fails to make Chief Seattle live as a strong character.

Te Ata and Clyde Fisher.

INVASION


COLUMBIA GROUND SQUIRREL ARMY
COLUMBIA
RICHARDSON GROUND SQUIRREL CORPS

By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

THIS year invasion has a different meaning to us than it did a few years ago. Then the powerful forces of our enemies were overrunning the countries of Europe, Asia, and the Islands of the Pacific. Great Britain, Australia, and our own West Coast wondered if they would be the next to feel the tread of the invader. Now the tide is running the other way and the Allies are invading, not without difficulty and loss, but with full assurance of the final outcome.

Among the animals there is nothing quite like the wars men fight. The flesh-eaters kill and eat their prey; house rats in times of scarcity devour the smaller and weaker members of their own species; and individuals of almost all kinds fight in self-defense or to secure mates and food. Man is the only creature, except for some insects, that fights in fully social ways, the individual becoming part of a unified group, sacrificing himself, if need be, for the common cause.

Invasion on the other hand is common. Some species are always extending their borders; others are forced to move back or gradually become extinct. This conflict between species is not organized, but it is like the struggle for existence among individuals, more like competition in business. The firm that produces a better mousetrap in a freely competitive situation will sooner or later take over the other mousetrap factories or drive them out of business, and when two species meet which have similar habits and the same requirements of food and shelter, one must give way to the other. Distinct species, no matter how closely related, do not mix or blend. One kind will have fewer enemies, better resistance to disease, more rapid reproduction, or better fighting ability. Even a small advantage is enough to give one species success over its rival. Changing climate, the breakdown of barriers, the spread of certain plants may produce conditions helpful to one animal and injurious to another, and the history of mammals is filled with changes in distribution. These movements of animals take place slowly and they are only rarely observed happening.

A few years ago the Columbian ground squirrels in the southern Canadian Rockies began to extend their territory. At that time the yellowish Richardson ground squirrels lived on the floors of valleys that extend from the plains into the mountains, while the larger, rusty colored Columbian squirrels had the higher valleys and slopes for their homeland. Gradually the mountain animals pushed out into the flats until they had occupied the valleys, once the country of the yellow "gopher." Mammals "invade" in this fashion, taking over a few miles here, a few acres there; the larger kinds spread more rapidly, the smaller ones more slowly.

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MARTINIQUE—

Continued from page 53

birds all facing inward, while that of the leader was a tall cone-shaped structure with a wing-flap on each side and a single bird surmounting the whole thing. Little mirrors were fastened to both the upper part of the costumes and the headdresses; and their faces were dotted with red paint on a background of the same sulphurous yellow as their wooden gods.

The dance began slowly, the three side by side first planting the foot flat before them, lifting it, and with a syncopated motion, pointing the toe in back, and repeating with the other foot. This was the basic step of the whole dance, with slight variations. The upper part of the body turned stiffly from the waist, only the arms swaying gracefully in rhythm. Soon the tempo was stepped up and their brown feet beat and swirled in the dust; but even at its fastest the dance remained solemn and dignified.

One of the most impressive things about the whole ceremony was the calm, accepting way everyone regarded the proceedings. The only break in this almost stolid atmosphere was the momentary frenzy of the priest, which subsided quickly and evoked not a single response in anyone else. To them it was all a well known ritual that they had probably witnessed every August of their lives, and though they watched with what might be taken for disinterest, you felt the pull of centuries past that made them burn flowers to their stone idol even as they lit candles in their churches to the Virgin Mary. The priest himself wore a catholic medal around his neck, and when you asked any of them what their religion was they answered sincerely and simply, "Mais, catholique, bien entendu." —"Why, catholic, of course." The faiths have become so fused that there is no sense of conflict. In some places the regimes under which the natives have lived have forced the primitive beliefs into a secret cult. Obviously, this has not happened in Martinique, for which we can thank not only the administration but the Church there as well for their truly French comprehension of the real human concept back of their ideal of moral liberty. If there is anything that weans the natives from their old practices and beliefs, it is not necessarily the Christian church but the inexorable march of "civilization," which unfortunately is apt to bring with it as much dissatisfaction for the heart and soul as it does satisfaction for the mind and body. If only some day we can learn to administer this civilization in small doses by a kindly hand and with full understanding of racial differences, perhaps we can avoid the breakdown and demoralization of whole peoples who are decidedly worth preserving.

CLOVER HOBBY

By Mark Barr

Like lots of other people, I have a number of hobbies. They relieve me from anxious thoughts in grooves. In these days, a man without a hobby is at the mercy of printed headlines; his ears are without refuge from sorely disturbing radio talks. The hobby of which I write provides a little sanctuary from troubled concern. In power of relaxation it resembles sleep. It has something in common with quiet conversation, with soft music, and with the splendor of fine pictures. Yet it is a simple, almost silly thing. It is the searching for four-leaf and other rare clovers.

It has been said that I hold the world's record, but if I begin by mentioning my record it will seem to be a matter of conceit. It is the opposite. I detest knowledge for its own sake, and the more I learn the more I realize how little I know of our infinitely mysterious universe.

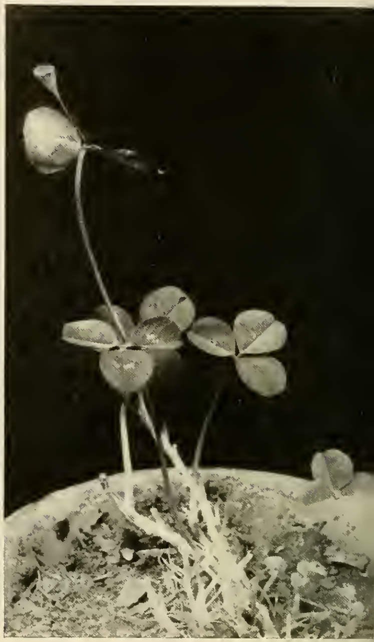
The finding of rare clovers has a technique. Do not glance about, quickly moving the eyes. More important, search where there has been an interference—a dropped brick, a newly planted tree, or, best of all, along the edge of a footpath.

One day in Essex, England, an old classmate of mine saw me looking down as we walked through his clover field. "Ah, there you go! Your curious hobby. Tell me, how do you do it?"

I mentioned the effect of a footpath. "Come," he said, "I have a narrow, ash footpath over there." He took out his watch and in less than 25 minutes I found 63 five-leaf clovers! Never before or since have I had such luck. I was more astonished than my friend. The clovers were promptly glued on a large sheet of bristol board, and twelve guests signed their names as witnesses.

Eighteen months ago near Croton, New York, I found 72 four-leaf clovers and six five-leafers in 35 minutes. According to statistics, five-leafers are 20 times more rare than four-leafers, seven-leafers about 100 times rarer, and six-leafers 300 times rarer.

Rarest of all is the cornucopia leaf shown in the photograph. Instead of a leaf, it is a closed cornucopia *without a midrib* but of the same chlorophyll green as the normal leaves. I found the first in 1886 and sent it to *St. Nicholas Magazine.* Thirty-four years later I found the second in England. Sir Daniel Hall, the botanist of Rothamstead, said that none had ever before been found there. And now, to my amazement, this summer in the Bronx I found eight more! I at once took them to Dr. H. A. Gleason of the New York Botanical Garden, and he confirmed Hall's statement.



Rarest of all clover leaves is the cornucopia, seen at upper left. This example was found in The Bronx

It has been possible in certain cases by crossing isolated plants of the same rare sort to produce a permanent type. But many of these revert, that is, produce seeds of the original common variety. In a botanical garden in Switzerland, many years ago, I came upon a large bed of four-leaf clovers. Every plant had four leaves. A sign read "Do not touch these," or words to that effect. I rushed in to see the head botanist, and he told me that after five years of work, crossing and recrossing, he had got a four-leaf clover plant. "But alas," he said, "it reverts to the common three-leaf type in the third or fourth year."

So treat your clover prize differently from your discovery of a preciously uncommon, closed gentian flower, or a rare bird. Whenever you find a four- or five- or six- or seven-leaf or cornucopia clover, pick it. Its parent plant may, next year, produce nothing but three-leafers.

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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Is Evolution through Co-operation Enough?

Mr. Clarence Johnson of Watertown, New York, writes to the Editors of Natural History Magazine that "Prince Kropotkin, who was Darwin's friend, asserts that Darwin in his later years became interested in the idea of Evolution through Co-operation," and he suggests: "If you were to devote some issues of your magazine to this aspect of development, you would open up new realms of thought. And you would make plain to your readers matters which at this time the world sadly needs to consider."

Our answer to this thought-arousing letter follows.

Evolution through co-operation was assuredly not unknown to Darwin, who knew so well the services of bees to each other and the exchange of services between bees and flowers, to say nothing of his citations of self-denying efforts and care on the part of many birds and mammals toward their helpless young.

Prince Kropotkin's book traces the long story of co-operation, especially in the Middle Ages: of soldiers in pillaging civilians, of peasants, revolting against the tyranny of their lords, of citizens in defense of their cities, and the like. But very often these co-operative efforts involved or led to aggressively competitive and destructive acts. And even now the interacting principles of co-operation and competition have parted most of the world into two great warring groups.

Sir Arthur Keith, in recent articles in the *Rationalist Review* (1942) sees the close co-operation within the primitive family, clan, and tribe, as well as the hostility to foreigners displayed by most peoples, as parts of Nature's method of promoting the isolation of small communities, the inbreeding of native strains, and the production of new varieties. These in turn are thrown into the competitive struggle for survival.

Long ago the baboons worked out a closely co-operative clan, led by the biggest and most aggressive bully. This unpleasant individual demanded and got the lion's share of everything, and left behind him the greatest possible number of young bullies and weaker servitors. To such brutish patterns the Nazis have added extensively: They have trained their youth in brutality and ruthlessness; they have developed a swaggering sense of superiority over the "inferior" peoples; they have stopped at nothing in heaping ridicule, shame, disgrace, and destruction upon those whom they have deliberately selected as scapegoats; and they have expanded the art and business of lying to intercontinental proportions.

Nevertheless it is becoming increasingly clear that the impersonal forces of Natural Selection are even now turning the scales of Justice and Retribution against the champions of mass murder, treachery, and world subjugation. Doubtless the baboon-like code was an important factor of evolution in days not yet entirely past. The same evolutionary forces have likewise been transforming human social patterns for thousands of years past but in various directions; and now a new general pattern is rapidly emerging through the close co-operation in war and peace of the United Nations. Both history and prehistory suggest, however, that the United Nations will succeed in defending and spreading their co-operative Good Neighbor way of life, and that such a happy state can endure, only so far as they can restrain their own destructive, competitive instincts and dedicate themselves to the unbiased and co-operative discovery and practice of international Truth, Justice, and Mercy.

William K. Gregory

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VOLUME LII—No. 3 ★ ★ ★ ★ ★ ★ **OCTOBER, 1943**

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From a Kodachrome by Ruth Bernhard

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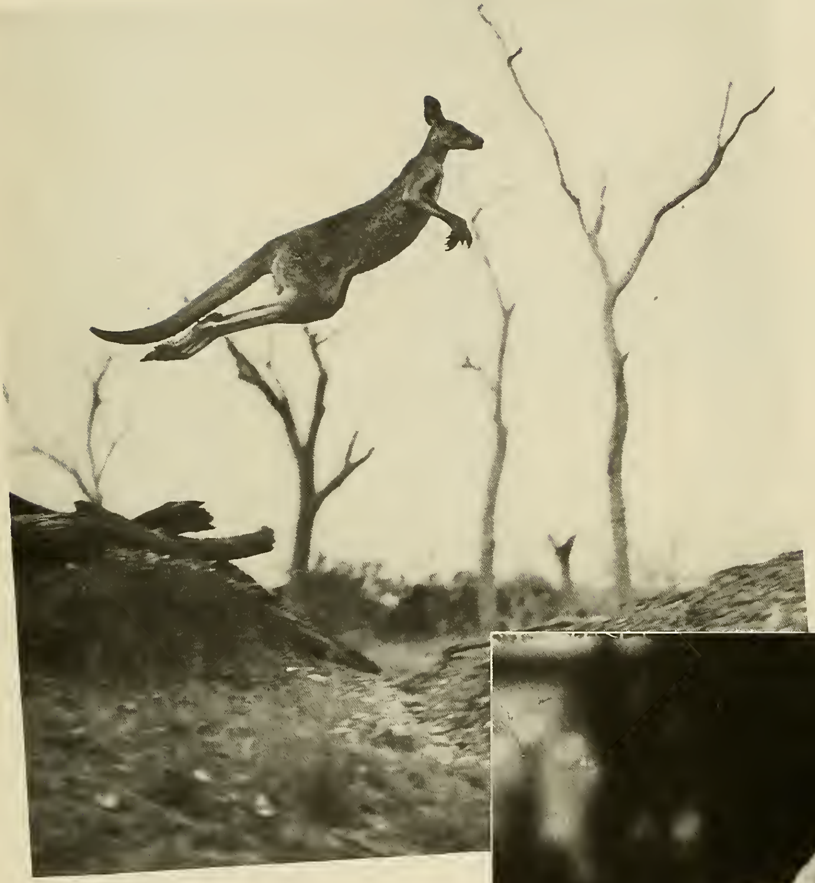
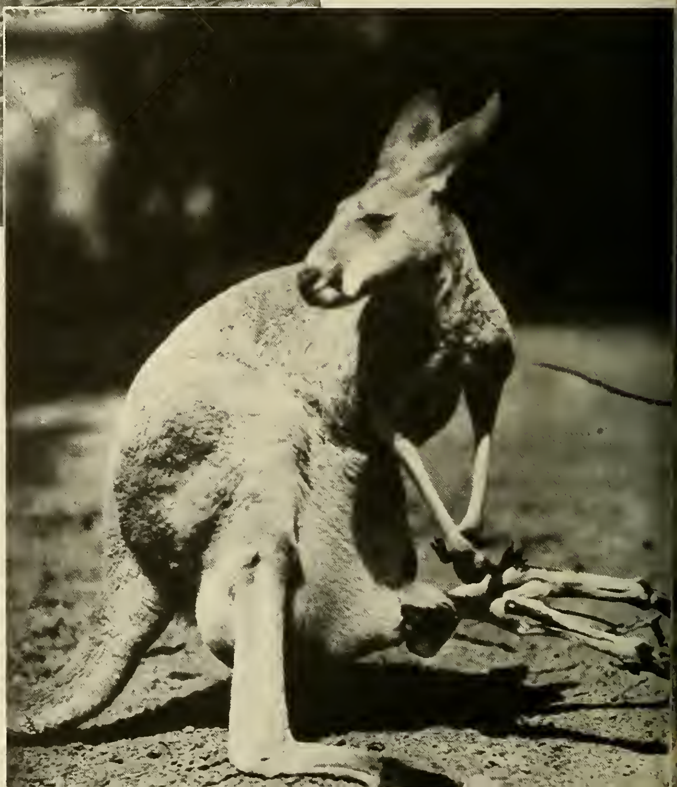
Seeing Nature *through*



A BROAD JUMPER of Australia: a Great Gray Kangaroo

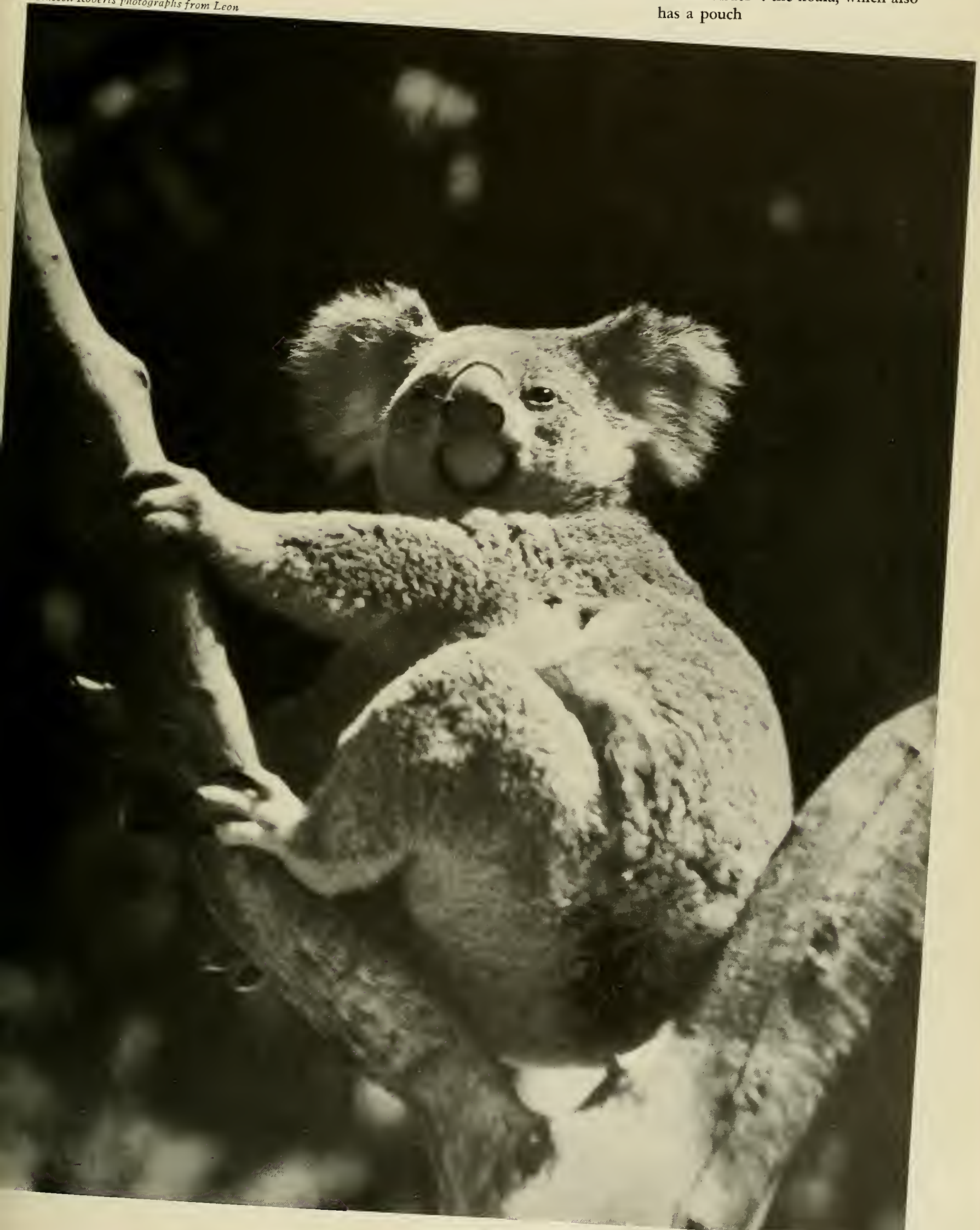


A RED KANGAROO MOTHER with her youngster in the pocket

THE CAMERA'S EYE

Russell Roberts photographs from Leon

ANOTHER NATIVE of the continent "down under": the koala, which also has a pouch



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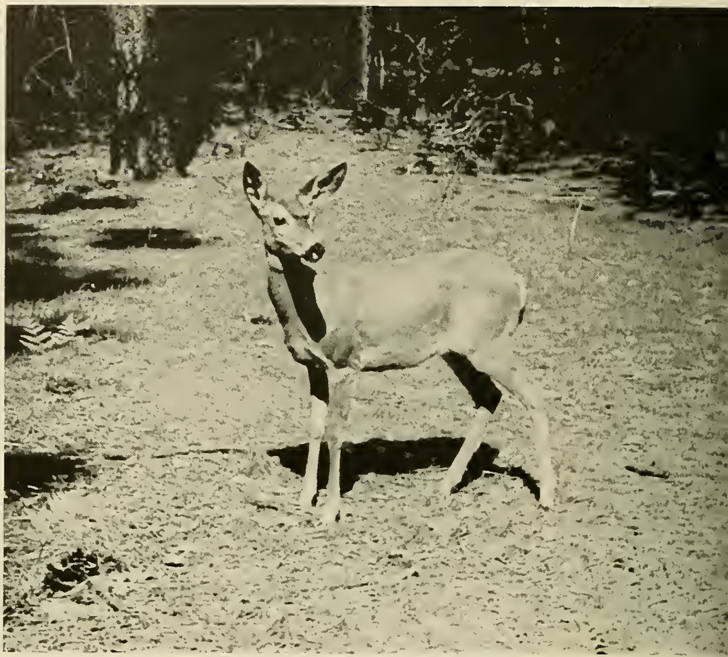
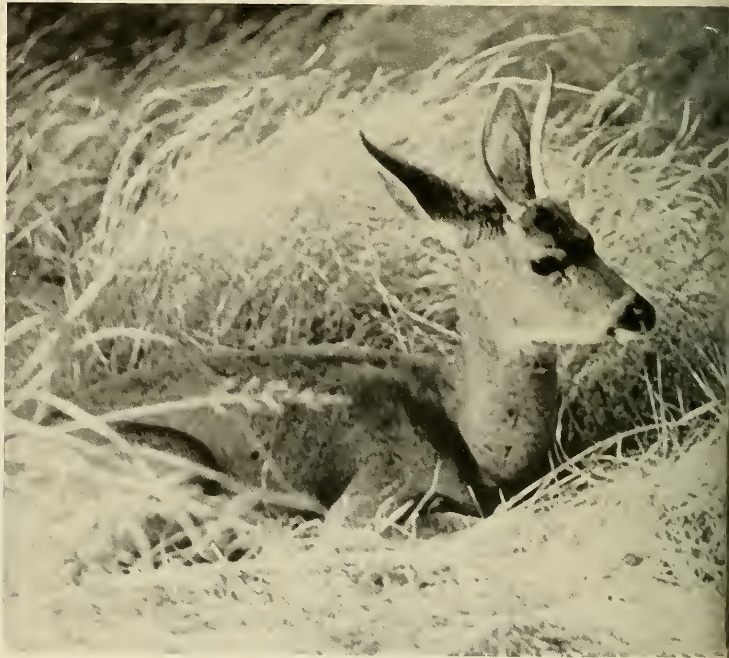




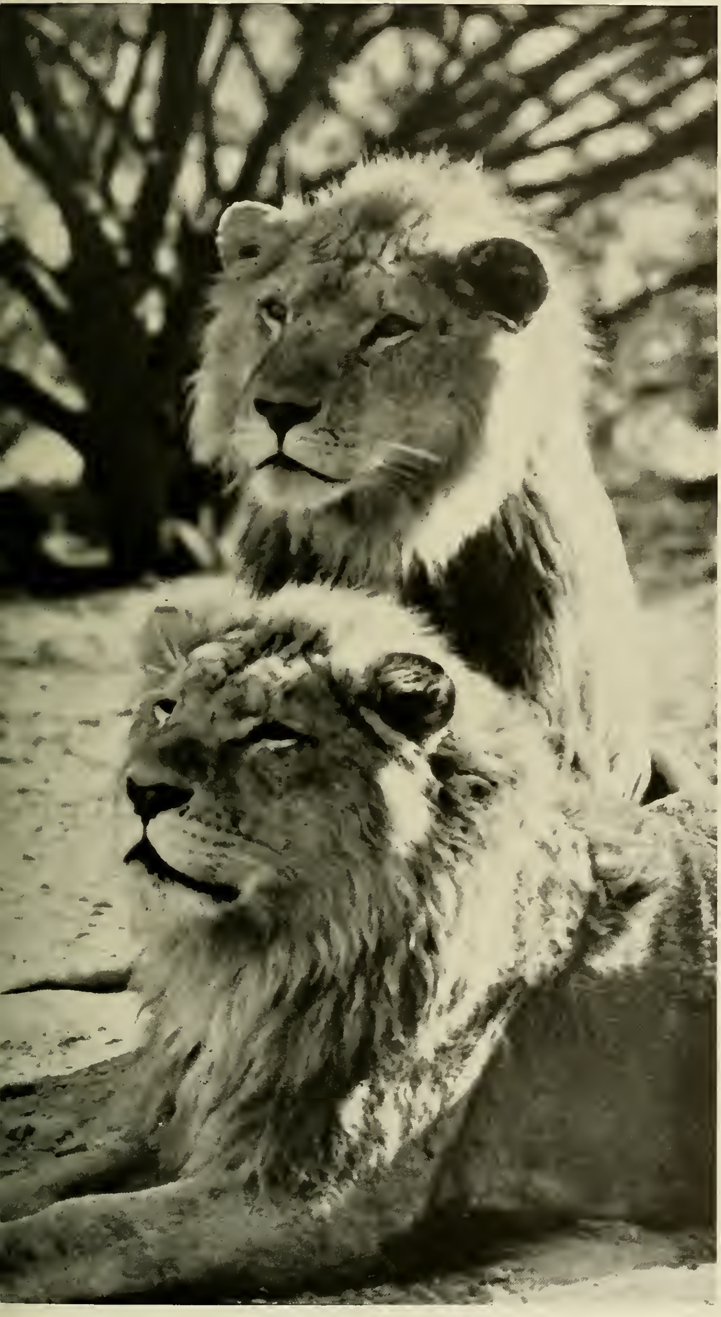
SIRS:

The three photographs accompanying this letter show two mule deer in Yosemite National Park—a spike buck and a doe—and a pair of lions in the African Replica at the New York Zoological Gardens. The pictures were originally taken on Kodachrome and then printed in black and white. The camera used was an Exakta with a Zeiss f:2 Biotar lens.

CPL. J. C. WILLIAMS.

Camp Edwards, Mass.

Continued on page 147



Adventures of
LONGINES
THE WORLD'S MOST HONORED WATCH
The watch that blazed a trail to Tokyo *

The watch above is the Longines Chronograph of Clyde Pangborn. Today, it helps navigate bombers over the Atlantic. In 1931, when ocean flights were branded as fools' missions, it served a world-flight that made front page news. Pangborn flew to Europe, across Russia to Chitka and thence to Tokyo. There he was welcomed by the police and lodged in the Tokyo jail! Japan didn't like free-flying Yankees. ¶The matter was settled by a stiff fine and Pangborn non-stopped his plane to Wenatchee, Washington, U.S.A. Pangborn had blazed a trail to Tokyo ¶It was he and the other pioneers of aviation who demonstrated the possibilities of the airplane. And Longines first pioneered the aviation timepieces which now, as then, are essential in air navigation.

*From documents in our files

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FLYING

The airplanes of prehistoric times —their distribution and habits

Of the many strange creatures that have inhabited the earth during past ages, the most extraordinary as well as the most highly specialized were the winged reptiles, the pterosaurs, sometimes called pterodactyls.

Appearing suddenly as highly developed animals more than 150 million years ago in the Upper Triassic rocks of Europe, they flourished in great numbers for millions of years and were widely dispersed over the world. Then, as suddenly, they disappeared, approximately 60 million years ago near the close of the Cretaceous Period. We know nothing of their ancestors, nor of their descendants.

The best preserved American and European specimens of these strange creatures are exhibited in the American Museum's Cretaceous Dinosaur Hall. At the northern end of this hall the visitor looks through an open doorway upon an arched inset panel 15 feet high and 8 feet wide, framed in white marble, on either side of which is a large vertical slab of dinosaur foot prints. This panel, occupying a strategic position at the end of the exhibition hall, has long been reserved for a mural painting of the winged reptiles as they appeared in life. This painting has now been completed and is reproduced opposite.

The view is of a rocky embayment of an inland sea, with bold cliffs of Cretaceous chalk rising above unconformable harder water-worn layers of Jurassic slate below. At the base of the cliff there is a narrow beach, with a trail of dinosaur footprints disappearing in the distance. Evening approaches, and the sun casts a glow of rich colors over the scene.

Soaring home to roost on the rocks are the toothless American fisherfolk of Cretaceous times; a giant *Pteranodon* (literally "Wing-Without-Tooth") with 20-foot wing span and crested head, followed by his smaller contemporary *Nyctosaurus* ("Night-Lizard"). The latter had a wing spread of six feet and lacked the head crest.

Clustered on the rocks below is a rookery of better known European kinds mostly of Jurassic age (approximately 120 to 155 million years ago), selected to show their great range in development.

Under the direction of the writer, a celebrated Russian artist, Constantin Astori, created many sketches, then painted the mural in collaboration with the delineator Alastair Brown, who drew the animals.

The high narrow panel offered a considerable problem in composition, but eventually the difficulties were turned to advantage in creating an illusion of a window opening into a vista of the past.

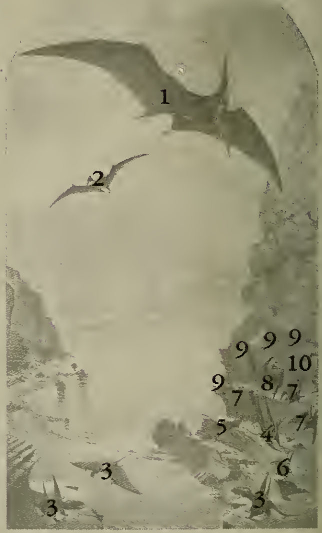
As the best known Jurassic pterosaurs ("Winged Reptiles") have been found in Europe, and the best known Cretaceous forms come from America, we took considerable liberty in treating the subject and locale in one painting; but after all, why not? Airplanes eliminate time and space.

Probably the most highly developed of these flying machines was the huge Dive Bomber *Pteranodon,* the largest figure in the painting. In this animal, specialization was carried to extreme limits. Its body was short and relatively small, with only a rudimentary tail; and its legs were slender and weak, with toes small and delicate. The skull was large but lightly constructed, and the great crest extends backward almost as far as the long, delicate, toothless beak projects in front. I interpret this highly developed crest as a sort of rudder which served the animal when, on folded wings, he hurtled through the air for his prey. The neck was moderately long, strong, and flexible. It had a remarkable series of additional articulations unlike anything found in the neck bones of other animals, which gave great thrusting and striking power to the beak. A rigid framework of fused backbones, shoulder girdle, and breastbone furnished support for the enormous wings and for the attachment of the muscles necessary to hold them in position, an arrangement unparalleled for strength among other animals.

The principal long bones of the

"Window to the past": the recently completed mural in the American Museum portraying a weird world of long ago in which reptiles soared through the air on enormous wings. William O. Sweet, sympathetic to Museum activities and a sponsor of two expeditions in which he served in Alaska and Texas, generously undertook to finance the mural as a memorial to his father, Frank Royden Sweet (1880-1936)

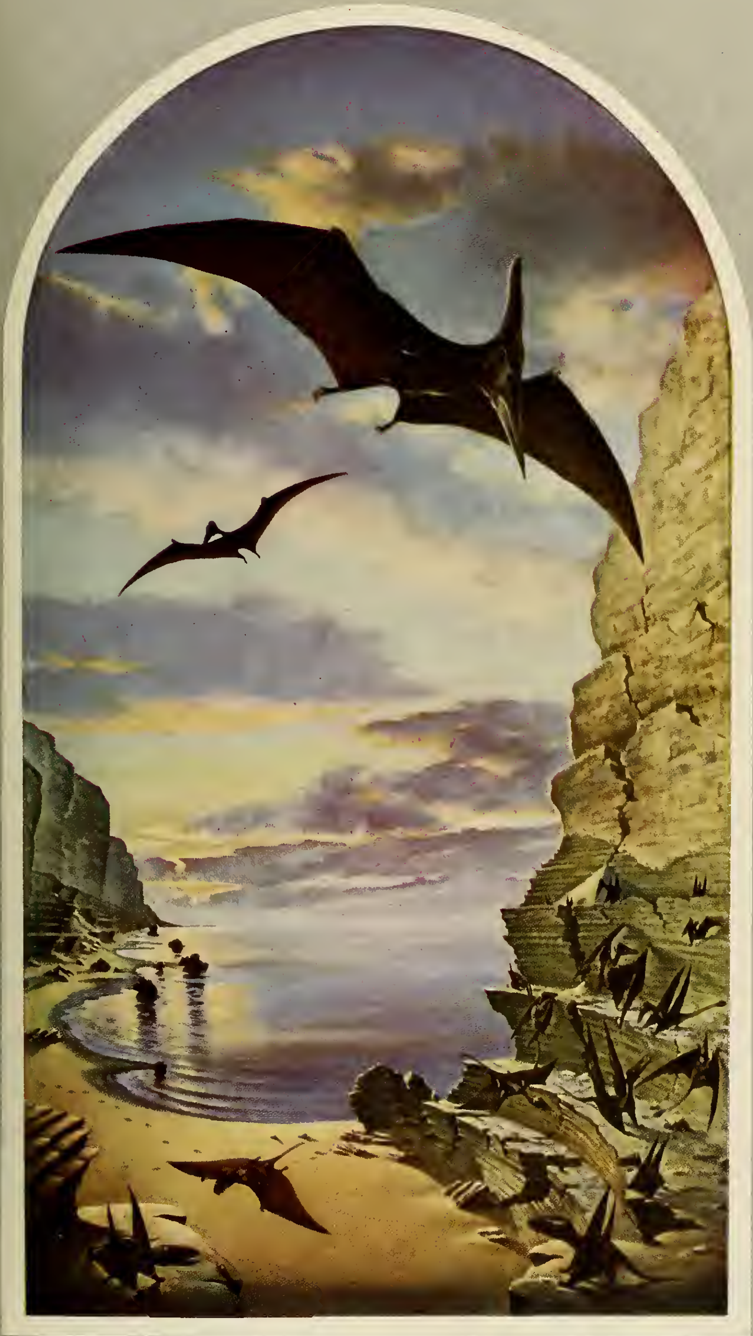
1	PTERANODON	("Wing-without-Tooth")
2	NYCTOSAURUS	("Night-Lizard")
3	DIMORPHODON	("Double-Shaped-Tooth")
4	CAMPYLOGNATHUS	("Curved-Jaw")
5	DORYGNATHUS	("Spear-Shaped-Jaw")
6	SCAPHOGNATHUS	("Hollow-Jaw")
7	RHAMPHORHYNCHUS	("Beak-Bill")
8	CYCNORHAMPHUS	("Swanlike-Beak")
9	PTERODACTYLUS	("Wing-Fingers")
10	PTENODRACON	("Winged-Dragon")



REPTILES

By BARNUM BROWN

Curator-Emeritus, Department of Amphibians and Reptiles, American Museum of Natural History



A.M.N.H. Kodachrome

body were hollow cylinders, with walls no thicker than blotting paper and openings that permitted air to circulate as in the skeletons of birds. On account of the pneumatic character of the bones and their thin outer walls, specimens are almost invariably crushed flat, which makes it extremely difficult to reconstruct their exact form in life.

Exclusive of the 20-foot wings, the body of the largest *Pteranodon* would be no larger than that of an albatross and in life would probably not weigh more than 25 pounds. Even when petrified, the body of a 22-foot specimen weighs less than ten pounds. In the air *Pteranodon* was supreme as he soared over the Cretaceous sea, searching for fish in the waters below. A lower jaw recently prepared in the American Museum contained the remains of a last supper—backbones of two species of fishes and the joint of a crustacean, lying in the position of the throat pouch when death overtook the animal.

Nyctosaurus, which lived at the same time as *Pteranodon,* was very much smaller. Its body was only about six inches long and four inches in diameter—approximately the size of a pigeon—though the wing spread reached six to eight feet. *Nyctosaurus* was toothless, and its long, straight ribs probably extended into and supported part of the flying membrane, as the ribs do in the modern flying lizard. It was less specialized than *Pteranodon,* and probably had different feeding habits.

At the base of the cliff in the mural is *Dimorphodon* ("Double-Shaped-Tooth"), the oldest and one of the best known genera found in the Lower Lias (Jurassic) rocks of England. In order to bring out more clearly its peculiar anatomy, three individuals are shown, two of them contending for an ancient cockroach. The head of *Dimorphodon* is very large and deep, and the numerous teeth, as the scientific name implies, are varied in shape. In the front of the jaw are large, irregularly spaced tearing teeth, followed by smaller ones behind and little close-set, saw-bladed teeth at the rear of the lower jaw.

Dimorphodon possibly fed on insects but could well have been an ancient beachcomber of varied feeding habits, for this animal is not so well constructed for flight as some other pterosaurs. The neck was comparatively massive, and there was a large pelican-like throat pouch. The hind legs were relatively large and powerful, terminating in large claws. The fifth toe was well developed for attachment of the flying membrane that extended along the moderately long, pointed tail.

Campylognathus ("Curved-Jaw") also portrayed on the lower rocks, is found fossilized in the Upper Lias (Jurassic) beds of England. It was closely related to *Dimorphodon,* but its skull was less deep and the lower jaws were not fused in front—a provision which, as in the ancient "sea serpents" known as Mosasaurs, permitted the animal to swallow comparatively large prey. In this genus the first joint of the wing finger is more than twice the length of the forearm, and the tail is extremely long. The feeding habits of *Campylognathus* were probably similar to those of *Dimorphodon.*

Dorygnathus ("Spear-Shaped-Jaw") was one of the early types that could well have walked along the shore with its wings folded as it scavenged near the water's edge. It was a long-tailed pterosaur but shorter than *Dimorphodon.* Its large skull was about four and three-quarters inches long, with the opening of the nostril much smaller than a large opening in the skull in front of the eye. Its remains are found in north and south Germany.

Scaphognathus ("Hollow-Jaw") had wings that would measure four feet from tip to tip, and the skull of a large specimen is seven and one-half inches long. Its wide-spaced teeth are large, and the neck is short and thick. The front and hind limbs are large, the tail short. The animal is characterized by its massive skull, in which there are three lateral openings of moderate size, the nasal opening being the smallest, and the eye socket the largest of the three. It is found in the Upper Lias near Whitby, England, and in the Lithographic Slates of Bavaria.

Rhamphorhynchus ("Beak-Bill") is one of the classic, best known representatives of the long-tailed Jurassic Pterosaurs from Germany. It was a powerful flyer. Its head was long and pointed, with enormous eyes, small upward-directed nostrils, and forward pointing teeth. The wing membrane, whose impression is preserved in several specimens, extends to the ankle. The long tail ended in an upright, kitelike rudder. It seems possible that this Pterosaur was adapted to the catching of insects in flight.

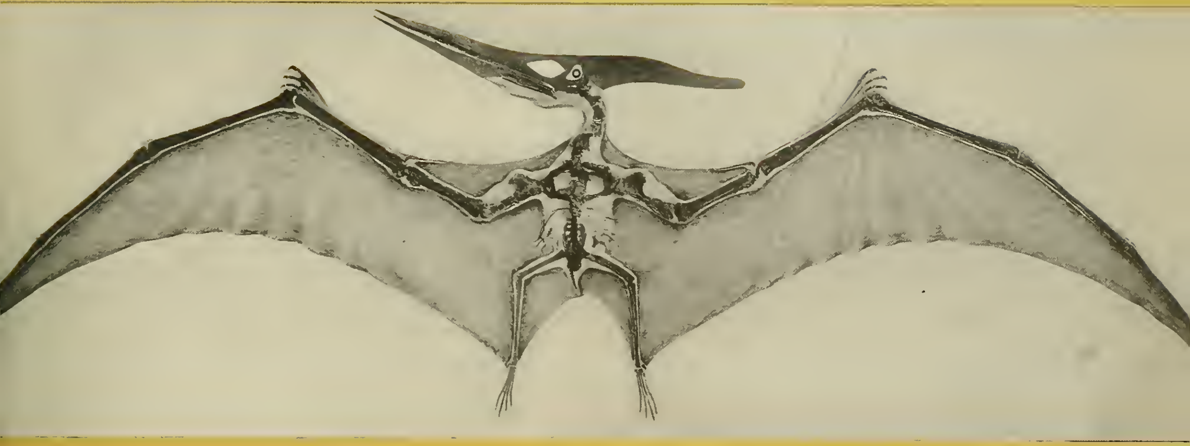
Cycnorhamphus ("Swanlike-Beak") appears to have been an active little creature. Its total length was 19 inches, and its wing spread about 48 inches. It was a long-necked, short-tailed Jurassic pterosaur from Germany, in which the wing membrane reached to the knee and the hand was extraordinarily long. Its upturned snout was armed with sharp, massive teeth.

Under the generic name of *Pterodactylus* (literally "Wing-Fingers") are included no less than 23 different species of pterosaurs, found chiefly in the Lithographic Slates of Germany, but also in the Lias, Wealden, and Kimeridge Clay of England. They are mostly small or of moderate size, varying from the size of a blackbird to that of a goose. In one of the large types the head is 8 inches long, and the wings could have extended at least 60 inches.

The first remains of a pterosaur to be discovered were thought by Collini to belong to an animal that lived in the water when he published a description of them in 1784. However, the same specimen was examined by the French naturalist Cuvier in 1801, and he recognized it as a flying reptile and named it *"Pterodactylus longirostiris."* As the name implies, the nose is extremely long, and the head and neck are twice as long as the body and tail. The wings were comparatively short, and the legs relatively strong. This combination indicates that this tiny, big-headed creature was active on the ground and did not depend so much on flight.

The smallest pterosaur known is *Ptenodracon* ("Winged-Dragon")—an animal about the size of a sparrow. The head measured little more than an inch in length. It is only known from the Lithographic Slate of Germany.

As flying creatures, the pterosaurs show the highest degree of specialization ever attained among animals with a backbone. The ratio between wing surface and body weight in some has been excelled only among some of the insects. All the bones of the body were hollow and lighter in construction than in any other animal that has ever lived. No fewer than 14 genera and many species of pterosaurs are recognized in Europe and America. Among them there is considerable variation in the different elements of the skeleton, but the general plan of their framework is essentially the same in all.



A.M.N.H. photo

NATURE'S LARGEST "ANIMATED FLYING MACHINE": the dive-bomber *Pteranodon.* Note the head crest which doubtless served as a rudder when this prehistoric animal folded its wings and hurtled downward on its prey. The 22-foot wings supported a body that probably weighed no more than 25 pounds

Quite clearly some kinds were better developed for air travel than others. Indeed, if we interpret correctly they were specialized for different kinds of flight as are airplanes today. But they were all gliders. The restrictions of wing movement in the skeleton did not permit them to beat the air as do birds and bats.

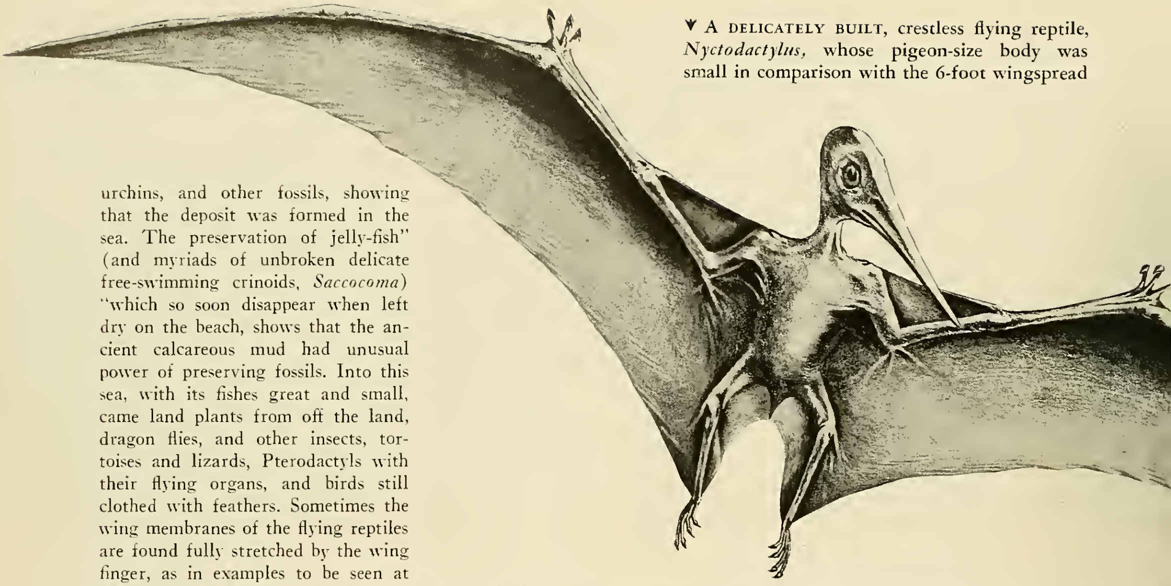
Many backboned animals of today are said to fly, but only a few possess true wings capable of sustained, controlled flight, notably most birds and one order of mammals—the bats. In birds the forearm or wing is constructed for the support of membranes to which are attached feathers that vary in size among different groups and determine the degree of speed and maneuverability in the air. The bat wing is of entirely different construction. It is a hairy membrane supported by the arm and greatly lengthened finger bones, which spread like the ribs of an umbrella. This membrane is further attached along the body, hind legs, and tail.

Several other kinds of backboned animals are capable of suspension in the air for a limited time through the use of expanded skin tissues. The flying squirrel is a familiar example. But these lack the capacity for sustained flight and should not be called flyers. Other parachutists in this class are flying fish which have greatly developed breast fins, and flying frogs, with spreading fingers and toes connected by membrane. Also there are flying lizards, whose ribs extend outward as far as the arms and are connected by membrane, and the flying opossums, flying lemurs, and flying foxes. All these have flaps of skin extending outward from the side of the body so as to connect with the front and hind feet. All these parachute-like accessories serve to buoy the body and reduce the shock of impact in landing.

As we see, however, long before these of the present era and before man's advent on earth, Nature was experimenting with living airplanes—the pterosaurs. That these experiments were successful is attested by the fact that the flying reptiles lived for no less than 40 million years and were dispersed over many parts of the earth, particularly in what is now western Europe and parts of the United States. Literally thousands of specimens are preserved in the museums of Europe and America, the most complete and perfect having been found in the Lithographic Limestones near Solenhofen, Germany. So perfect are some of these that even the wing membrane and the soft parts of the anatomy are outlined in proper relation to the bones. In one classic specimen in the American Museum, part of the body muscles overlie the bones as a film of delicate white threads. In others, ultra-violet light discloses the throat pouch and body outline.

Unfortunately the bones are so delicate and brittle and the stone in which they are found so hard that Museum practice does not permit the expenditure of time necessary for laboratory technicians to extract the bones for free mounts. It is certain, however, that the study of free-mounted skeletons would disclose principles of flight and relationships between wing load and body form and weight that would be of practical importance in the field of aviation. For example, the cross-section of most of the wing-finger bones in the great Cretaceous glider *Pteranodon* is round while that of *Rhamphorhynchus,* evidently developed for gliding movement, was elliptical in cross-section.

Near Solenhofen in Bavaria, southern Germany, is found the Lithographic stone long used for etching purposes. "These beds," to quote from H. G. Seeley, "belong to the rocks which are named white Jura limestone in Germany, which is of about the same geological age as the Kimeridge clay in England. Much of it divides into very thin layers, and in these planes of separation fossils are found. They include *Ammonites lithographlicus* and a multitude of marine shells, King crabs and other Crustacea, sea-



▼ A DELICATELY BUILT, crestless flying reptile, *Nyctodactylus,* whose pigeon-size body was small in comparison with the 6-foot wingspread

urchins, and other fossils, showing that the deposit was formed in the sea. The preservation of jelly-fish" (and myriads of unbroken delicate free-swimming crinoids, *Saccocoma*) "which so soon disappear when left dry on the beach, shows that the ancient calcareous mud had unusual power of preserving fossils. Into this sea, with its fishes great and small, came land plants from off the land, dragon flies, and other insects, tortoises and lizards, Pterodactyls with their flying organs, and birds still clothed with feathers. Sometimes the wing membranes of the flying reptiles are found fully stretched by the wing finger, as in examples to be seen at Munich and at the Yale Museum in New Haven, in America.

"The Solenhofen slate belongs to about the middle period of the history of flying reptiles, for they range through the secondary epochs of geological time. Remains are recorded in Germany from the Keuper beds at the top of the Trias, which is the bottom division of the secondary strata."

In England the earliest remains are found in the Lower Lias of Lyme Regis, in Dorset, and the Upper Lias of Whitby, in Yorkshire. Subsequent ages are well represented in other localities; and in the Cambridge green sand there are thousands of fragmentary remains, which cause one to wonder whether these reptiles may not have been strongly gregarious. One visualizes rookeries like those of modern penguins and other shore birds.

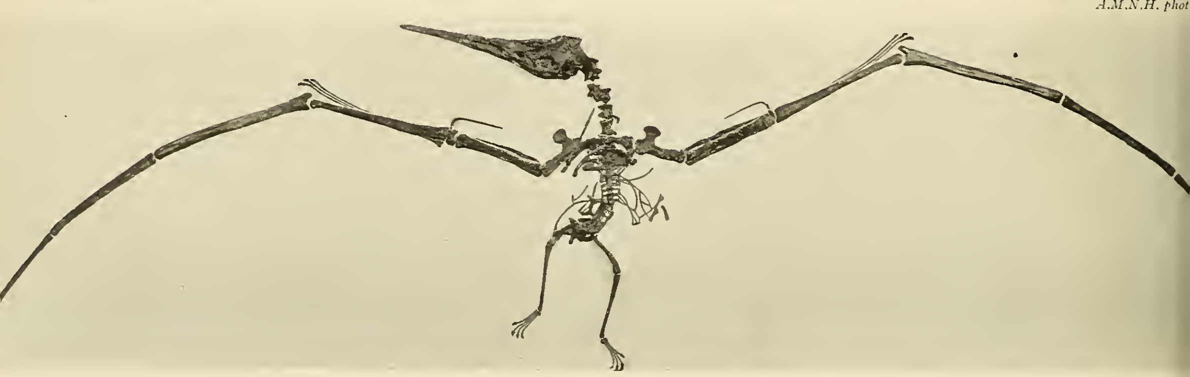
In western United States flying reptiles were numerous at the time when the Pierre shales of Niobrara County, Wyoming, were laid down in the Upper Cretaceous Period, sometime between about 60 million and 100 million years ago. They are better known and more plentiful in the Niobrara chalk beds in western Kansas. Here thousands of bones and incomplete skeletons have been recovered, representing types related to the two shown in flight in the mural. *Pteranodon* is also reported from Upper Cretaceous rocks in Oregon, but the identification may prove to be erroneous, for in many respects the single known specimen is not typical of the genus.

From Clark County, Kansas, a third genus, *Apatomirus,* is represented by a single bone, the head of a femur, or thigh bone. This is a more primitive type and more ancient, coming from Lower Cretaceous rocks (between approximately 120 and 100 million years ago).

The oldest representative of the race in America is *Dermadactylus,* whose name means literally "Skin-Fingers" and refers, of course, to the modification of the hand into a wing.

▼ THREE FINGERS of the flying reptiles were generally equipped with claws for hanging onto rocks when at rest. The fourth was greatly elongated for the support of the wing membrane, as seen in this skeleton of *Nyctosaurus.* In birds, on the other hand, overlapping feathers form the wing surface, with the bones of the forearm acting as the main support. And in bats the arrangement is still different: the fingers fan out like the ribs of an umbrella to support a hair-covered wing membrane

A.M.N.H. phot



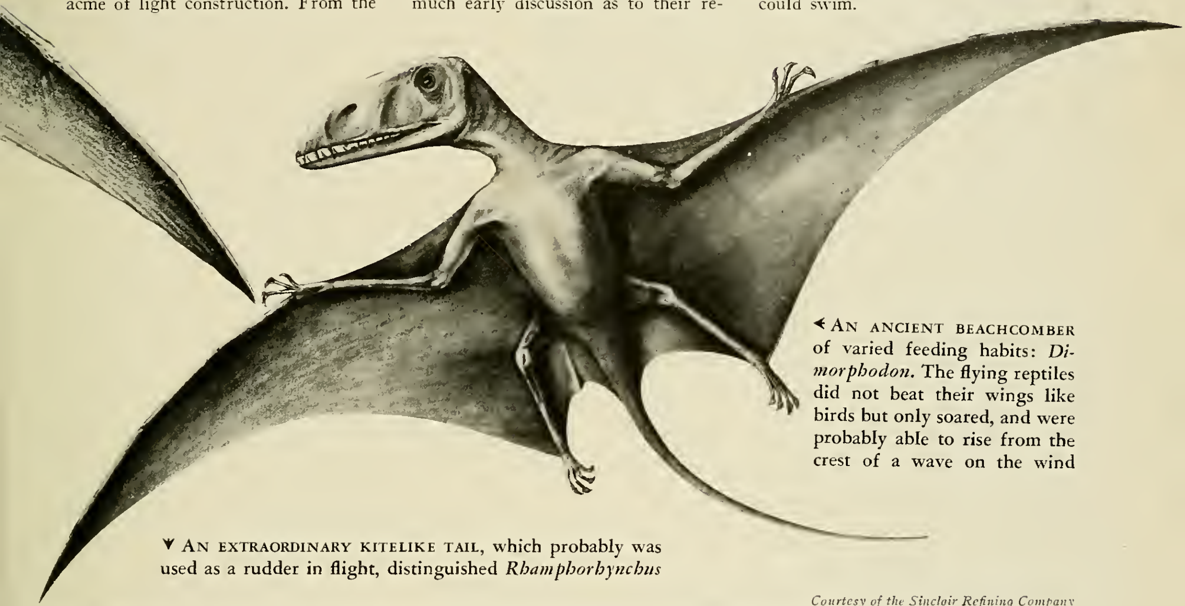
It is represented by several bones found in beds of Jurassic age (between about 155 and 120 million years ago) at Como Bluffs, in Albany County, Wyoming.

A fifth genus, as yet unnamed, is of especial interest because it represents the last survivor of this ancient race in America and probably in the world. It has been found in south central Texas in rocks of Upper Cretaceous age (Eagle Ford Limestone). The creature's identification is based on the upper part of an arm bone (the humerus), but there is no doubt of its relationship. Here, in the culmination of the pterosaurs, we reach the acme of light construction. From the earliest representatives to the latest yet found, there is a gradual reduction in the weight of the bone structures. In the specimen just mentioned the bone tissue is only one-half millimeter thick, or about one-fiftieth of an inch.

Another feature in the evolution of pterosaurs was the change from long-tailed types among the earliest representatives to short-tailed forms among the last survivors. Notice the curious rudder-like appendage that *Rhamphorhynchus* carried as illustrated in the restoration.

The skeletons of the flying reptiles are so highly modified that there was much early discussion as to their relationships and proper position in the animal kingdom. Some thought they were birds, others amphibians. But now there is no longer any doubt of their reptilian affinity. Unlike other cold-blooded reptiles, however, their circulatory and respiratory systems were probably as highly developed as those of birds, and they may well have been warm-blooded.

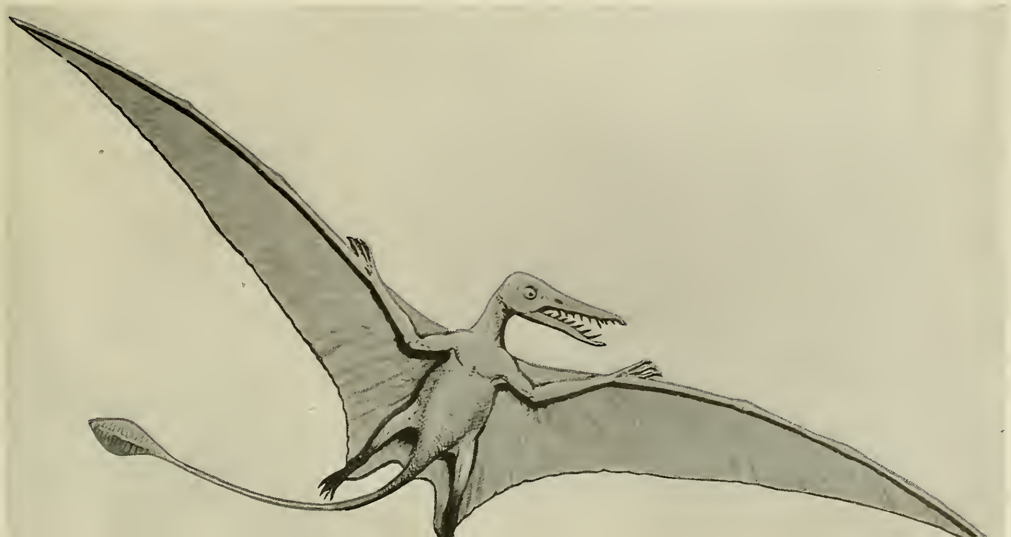
In most respects, the skeleton is reptilian, but there are a few features common to birds and mammals. Although constructed chiefly for locomotion in the air, these animals could make some progress on land as quadrupeds. There is no evidence that they could swim.

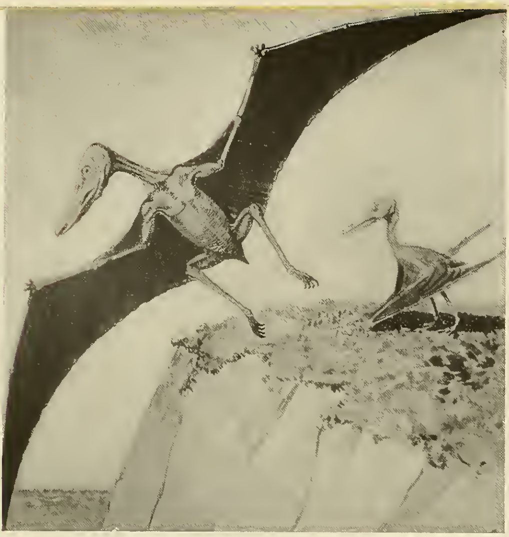


◂ AN ANCIENT BEACHCOMBER of varied feeding habits: *Dimorphodon.* The flying reptiles did not beat their wings like birds but only soared, and were probably able to rise from the crest of a wave on the wind

▾ AN EXTRAORDINARY KITELIKE TAIL, which probably was used as a rudder in flight, distinguished *Rhamphorhynchus*

Courtesy of the Sinclair Refining Company





Courtesy of the Sinclair Refining Company

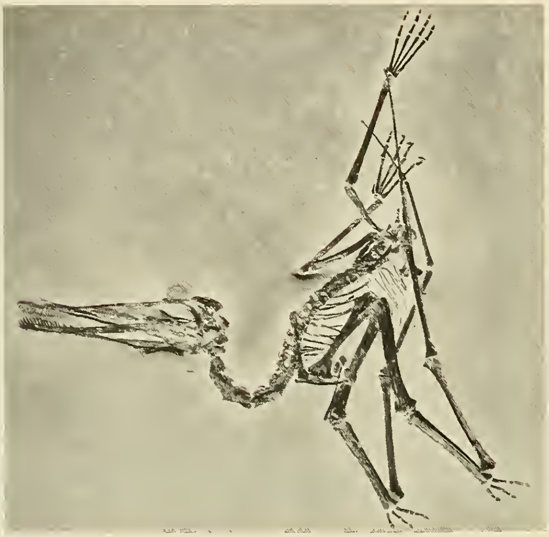
▲ Sharp, Massive Teeth armed the beak of *Cycnorhamphus,* an active little flying reptile with a four-foot wingspread. Note that the wing membrane extended only to the knee

Undoubtedly they were shore-living creatures, but some *Pteranodon* remains have been found in the chalk beds of Kansas 100 miles from the nearest possible shore of that inland Cretaceous sea. The opinion has been expressed that once down on the surface of the water they could not have arisen, but if they are considered as gliders, the great expanse of wing could easily have lifted their light bodies from the crest of a wave.

That they were more intelligent than living reptiles is attested by the brain, which is as highly developed as in the birds. There is no evidence as to whether they laid eggs or gave birth to living young. Both methods are common among living reptiles. Immature specimens have not been recognized.

In size the pterosaurs ranged from tiny little fellows no larger than sparrows to huge creatures with wing spread of 22 feet. In all pterosaurs, indeed, the dominant and most characteristic feature is the enormous size of the wing in relation to the body and the manner in which the wing membrane is stretched along the lengthened joints of the fourth finger and attached along the body, extending to the hind legs. The first three fingers are short and are equipped with claws at the end for hanging onto rocks when at rest. There is no "little" finger. Nearly all of the known European varieties were provided with teeth, but the large better-known American forms, and possibly the late English ones, were toothless.

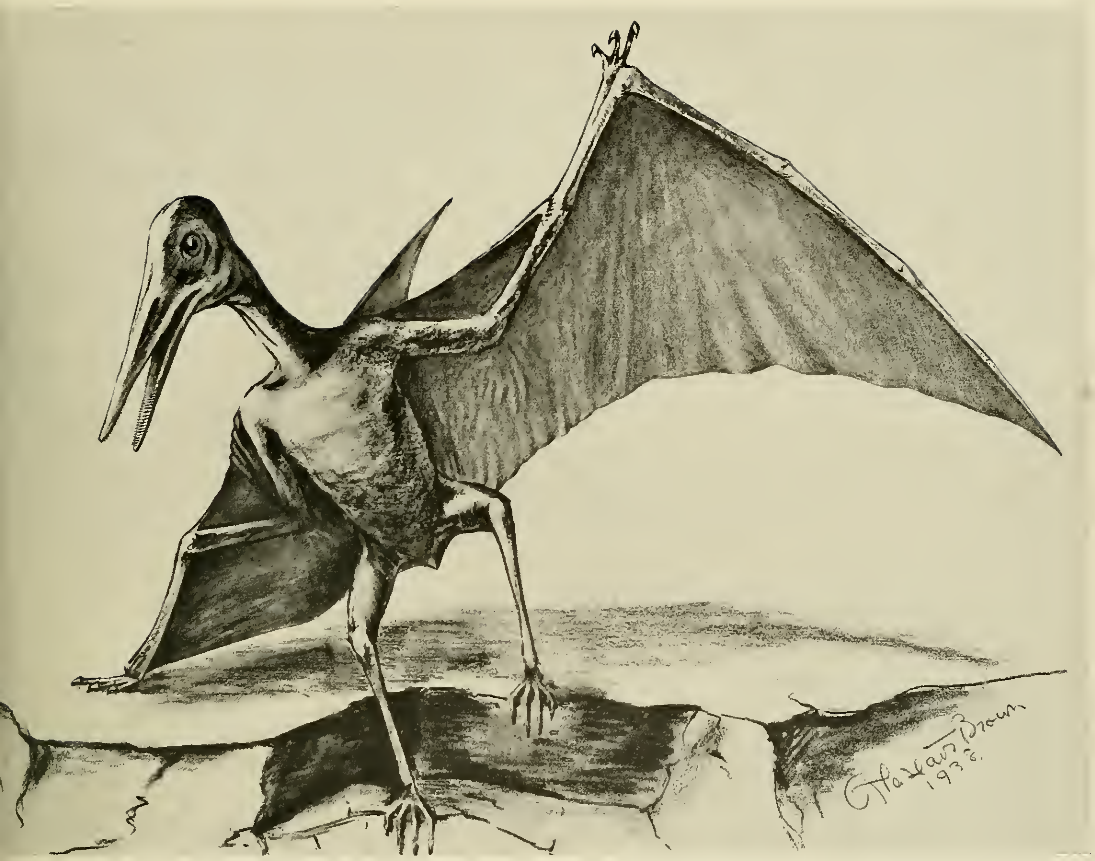
When one stands before the new mural in the American Museum looking upon the ancient scene, one is apt to experience some of the emotions of an explorer gazing out upon an unknown land. This "window" to another world presents a view unlike anything man has ever seen, yet it is a faithful representation of that distant age when weird winged reptiles large and small were masters of the air. In the world today there remain no living survivors of this early experiment in flight. One wonders why the flying reptiles did not last down through the ages. They had developed some excellent principles in their efforts to overcome gravity and rule the air. One of the most noteworthy ones is the tubular construction of their bones—a principle used widely today in airplane design. But possibly Nature carried it too far and made her animated flying machines too fragile. This may have been what spelled their defeat.



A.M.N.H. photo

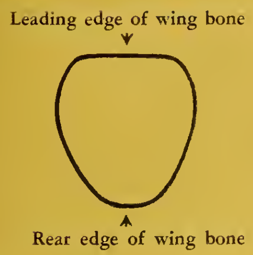
◄ A flying reptile scarcely larger than a blackbird: the skeleton of *Pterodactylus elegans,* as found preserved in rocks many millions of years old. The flying reptiles had hollow bones with extremely thin walls. The delicate remains are crushed flat in the hard layers of rock, making it difficult to extract the bones for free mounts

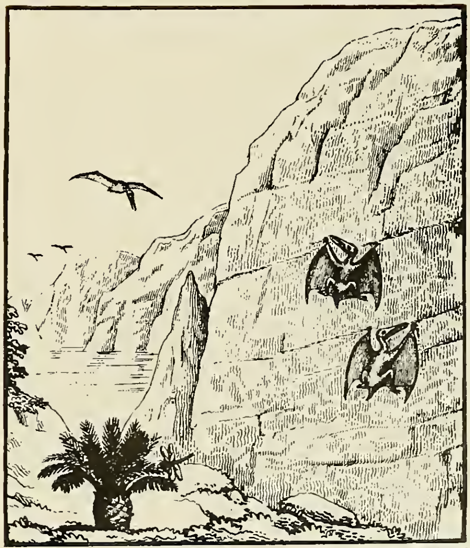
► The hollow bones of the flying reptile grew thinner until they were sometimes n thicker than blotting paper, as illustrated i the drawing at right. This is a cross-section o the upper arm bone of one of the last of th Pterosaurs, found near Austin, Texas. Tubular construction to gain strength withou weight is effectively used in airplane construction today, but the flying reptiles ma have carried the principle too far


G. Harlan Brown
1938.

A RESTORATION showing *Pterodactylus* as it appeared in life

➤ THE SMALLEST pterosaur known: *Ptenodracon,* a creature about the size of a sparrow, with a head little more than an inch long


Leading edge of wing bone
Rear edge of wing bone



After Buckland

America's Greatest Host

The largest animal in North America was 50 million strong when the white man undertook to conquer the continent

By Donald Culross Peattie

PROBABLY more than a million Americans toiled slowly and painfully over the prairies before the railroads crossed the continent. For over half a century America's greatest host served those million people, and served them royally. He fed them with juicy fresh meat, and supplied them with fuel where there was not a stick of wood to burn. At night and in winter he covered them with rich robes. He showed them the way to the waterholes and to the fords where the covered wagons could cross. At his own cost, he furnished supplies to construction gangs that finally laid the railroad tracks. The United States Army posts depended on him. Many great American fortunes were built in part on his good services. No wonder this old hero is immortalized on our five cent pieces.

His name was "Old Man Buffalo."

The bison or American buffalo was, and is, the biggest animal on the American continents. A full-grown bull stands, on the average, six feet at the shoulder and is from ten to twelve and one-half feet long, tail included. But it's in poundage rather than size that "Old Man Buffalo" throws his weight around. A bull weighs a mean—very mean—1800 pounds, but 2400 pounds are recorded. The horns are not especially long amongst the cattle of the world, but the breadth of the savage crown between them is superb. One record head displays a stretch of 30½ inches from horn tip to tip. With those horns a bull could rip the rope-tough prairie sod to make himself a wallow, could toss a whole wolf pack, disembowel a horse, or even carry horse and rider aloft for a hundred yards before hurling them to the ground. More dangerous than a grizzly bear, a cow defending her calf can be one of the world's most ferocious animals. As for a herd of buffalo, no creature that stood its ground to argue with a stampede could live 60 seconds.

The American bison before the white man came was undoubtedly the most numerous of all the big land mammals of the earth. Naturalists have estimated its numbers variously, but nobody suggests that there were less than 50 million of these monsters in aboriginal America. The first white men who ever saw the vast herds of the Kansas plains were Coronado and his explorers, and they were dumbfounded at the incalculable multitudes. Even the early cowboys could not find words for the hordes of these prairie monarchs. That great plainsman Colonel Dodge describes a single herd 25 miles across, extending north and south as far as his eyes could see, which took all day in passing.

In their heyday there should have been enough buffalo to stock the nation's larder, especially if salted down and preserved. But owing to greedy wastage of this tremendous meat supply—the biggest game resource the Creator ever bestowed on a lucky country—not one third of the buffalo slaughtered were ever utilized. Certain epicures of the prairie slew bison only for their delicious tongues, leaving all the rest to wolves. Frequently buffalo were slaughtered only for the hides. Pioneers killed them to fatten their hogs. Millions were slain simply to clear them off the land.

By 1810 the bison were pushed over the Mississippi, and there was no trace of them in the eastern forests except the trails they had made walking in

A.M.N.H. photo

▲ Only a few protected herds remain. Exhibits like this one in the American Museum of Natural History serve to acquaint city-bound citizens with the animal our forebears a few generations ago knew so well

single file. Dan Boone's Wilderness Road followed in part a buffalo path from Tennessee, through Cumberland Gap to the salt licks of Kentucky. Many a city stands today where it is because the bison beat an ancient roadway there.

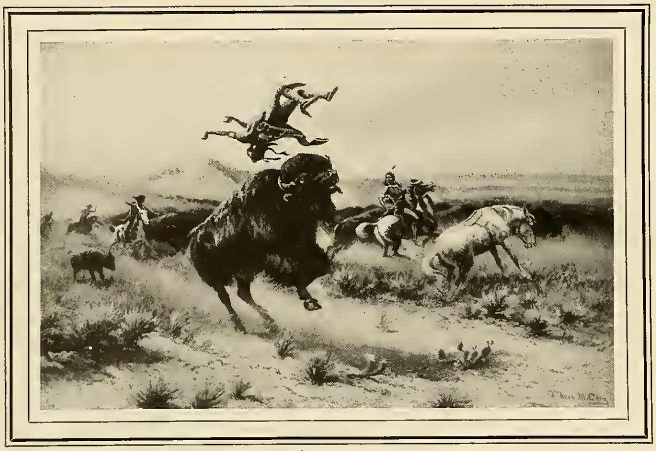
Doom came for the Plains herds with the Gold Rush and the laying of the transcontinental railways. "Old Man Buffalo" didn't take this invasion as a sitting bull; he met it head on. He pushed down the new telegraph poles. He stood on the railroad tracks and actually stopped the trains; charging between cars, he broke the couplings. In the Missouri River, when his herds were swimming across, early steamboat traffic might be stopped for several days.

But the Kansas Pacific Railroad hired Colonel William Cody at the fancy salary of $500 a month to clear snorting brutes from the right of way. With his gang of exterminators he decimated the herds. On a bet, Colonel Cody killed 69 in one day. In 18 months he had chalked up a score of 4280 bison. That's how he came to be known as "Buffalo Bill."

Confronted with systematic attacks like this, the buffalo faced their tragic destiny. For the great beasts had to go, of course, when the white men came. His farms, his fences, his cattle and sheep, his children and crops, could not share America with these ferocious monsters. But the nearer the buffalo came to extinction, the faster we drove them. The Santa Fe's "Buffalo Jones" declared that in 1865 there remained 15 million bison and that in that single year, one million were slaughtered. Half of the remainder were gone by 1872, the peak of the kill. Still the great herds were cornered and annihilated. In 1883, Montana's biggest herd of 10,000 was methodically exterminated in a few nights and days; sharpshooters guarded every waterhole during the burning summer hours and by firelight at night, and when at last the thirst-maddened brutes braved the bullets to get at water, not one escaped.

Much of this slaughter was for the sake of the hides, which had soared in price as they decreased in quantity. To speed the work, they were stripped off the carcasses by teams of horses, until they were heaped beside the railroad in piles high as Kansas haystacks, mile after mile. But as profits dwindled, the king of primeval America became the butt of sport. Toward the end it was fashionable for wealthy big game hunters and titled visitors to "kill the last buffalo." For Grand Duke Alexis of Russia, a hunt was arranged by General Sheridan, with General Custer, Colonel Cody, a pack of Indian scouts, and a troop of U. S. Cavalry to round up some of the lonely survivors within range; afterward a buffalo barbecue was held, laced with champagne.

Now where once the sovereign herds had thundered, lay only their bleached bones—acre after acre of them. Contemporary photographs show the plains white with them far as the eye could see. And still, in this skeleton form, "Old Man Buffalo" was friend to the pioneer. The bones had a high market value for use in sugar refining and for fertilizer, and many an early settler paid for his first seed, plow, and land fee, by selling the buffalo bones he cleared off his claim. For half a mile along the tracks would stretch a bone pile twice as tall as a man and of equal breadth. One dealer,



A.M.N.H. photo

◄ THE SHAGGY GIANT that made the Buffalo Nickel famous has inspired many an artist, as represented here by an example from the brush of William Cary. A large bull bison is said to be capable of carrying a horse and rider on his horns 100 yards

known as "Old Buffalo Bones," shipped 3000 carloads to Kansas City, and made a fortune out of it. The Santa Fe in three years carried nearly a million and a half tons of bones, until the scavengers had gleaned the last of this ghoulish harvest.

Yet where Old Man Buffalo had passed, he still gave light and warmth. For years after the herds had vanished, travelers across the treeless prairies found fuel in buffalo chips. Over such campfires many a heartening meal was cooked and many a tall tale told. And when even the chips were gone, prairie settlers still could trace, thanks to the grim Old Man, the way to the precious water holes. The buffalo paths that led there, for ages fertilized by the droppings of the great animals, were always marked by taller greener grass.

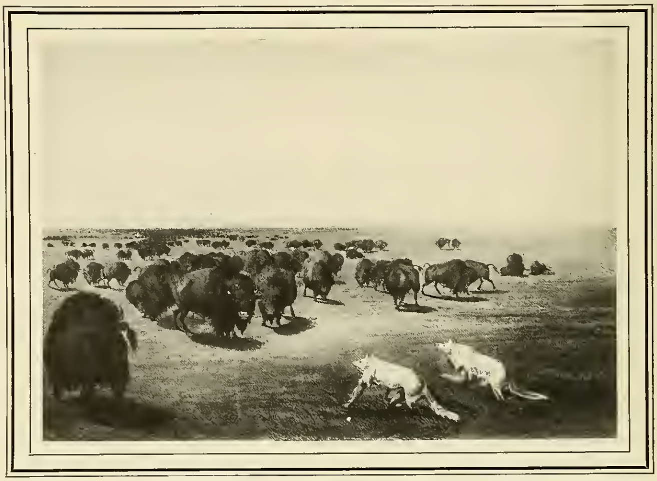
Now the prairie sod was broken and fenced; the rails criss-crossed the plains; the very wind was harnessed to the wells. The white man's cattle chewed a placid cud where the buffalo had roamed. Exiled, hunted, the last few bison were facing extinction. While President Grant vetoed a bill to save them, while Congress wrangled the cost of their conservation and shelved measure after measure for it, there seemed small hope that these survivors could brave out the storm. But a few men who knew the West perceived that some strength and pride of our own, some American splendor, would be gone when the last of the buffalo went.

Perhaps it was Walking Coyote, a Pend d'Oreille Indian, who proved the first friend of the vanishing buffalo. Walking Coyote roped two male and two female calves, and from that beginning grew the great Allard-Pancho and Conrad herds of Montana, from which are descended many of the pure-blooded bison living today. In the Panhandle, Colonel Charles Goodnight, at the entreaties of his wife, also saved a few wild calves which he lured home to protection on his ranch, and soon other appreciative westerners followed suit. In 1905 the American Bison Society was founded by Theodore Roosevelt, William Hornaday, and others, and raised $50,000 to create the Montana National Bison Range on the old Flathead Indian Reservation. Today there are fine herds also in Nebraska, Oklahoma, South Dakota, and Yellowstone Park, and a herd has been introduced into Alaska. In San Francisco and Washington, D. C., there are good exhibition herds, and altogether the bison population of the United States totals today more than 5000, while Canada can boast about 35,000 woods bison on its preserves.

There are actually more little buffaloes coming into the world today than there is range land free to accommodate them. So the rangers eliminate all sick and superannuated animals, and the herds are kept in fine condition. Unneeded calves are sold to zoos. If there is still a surplus of buffalo, it goes to the Indians. And this is fitting, for to the red men the buffalo is a creature of divine origin, a gift of the Great Spirit, that plays an ancient part in their religious ceremonies. To any American, "Old Man Buffalo" is a prized fellow citizen, and the memory of his former greatness will quicken our pulses, as long as bunch-grass grows and the west wind blows and a single bison horn is still turned up in the furrows of a prairie ploughing.

▼ INDIAN HUNTERS, depicted stalking their quarry under camouflage of wolf skins

A.M.N.H. photo



[THE SECOND OF A SERIES ON STRATEGIC PLANTS]

VITAL FIBERS

Ewing Galloway photo

By HAROLD N. MOLDENKE

RANKING close to Manila hemp, or abacá, in importance are sisal and henequén. Both are close relatives of the well-known centuryplant, noted for its habit of flowering only once and then dying. Readers who have traveled in our extreme Southwest may be familiar with the tall, flower-crowned stalk of the centuryplant, rising from a bristling rosette of pointed leaves.

It is from the leaves of the sisal and henequén plants that the valuable fibers for rope and twine are procured. So much was produced before the war that efforts were made to curtail production and develop new uses. The war has changed all this.

The fiber from both plants is sold as "sisal," but they are by no means identical. They require different conditions of climate and soil and are found in different regions. Both, however, were used extensively by the Aztecs and Mayas at the time of the Spanish Conquest in the sixteenth century. The tedious, primitive methods of separating out the fibers originally used by the Indians were later adopted by the Spaniards, but about 1830 a simple cleaning machine was invented. Its use led to a gradual spread of the industry. In 1834 both sisal and henequén were brought into cultivation in Florida, and young plants were grown in large enough quantities to permit distribution to the various other countries where these fibers are now being grown commercially.

Sisal *(Agave sisalana)* is used chiefly for binder twine, hard-fiber twines, mattress pads, floor mats, and porch furniture. It is produced in Haiti, the Bahamas, the Netherlands Indies, and East Africa. Enemy conquest and shipping difficulties have, of course, seriously cut down on our imports, and vigorous efforts have been made to step up production of this fiber in the Western Hemisphere. Haiti, for instance, exported over 25 million pounds in 1942, and, as a result, the economy of this island republic is undergoing vast changes.

on which the war effort and home front economy hang or fall

After flowering, the sisal plant, like the centuryplant, dies except for numerous "suckers" left around its base. These suckers are gathered and set out in rows on plantations. Harvesting of the first leaves comes about three years later, and crops are gathered annually for from five to seven years.

True henequén is the product of the closely related *Agave fourcroydes,* a slow-growing, drought-resistant plant. It is cultivated in Cuba as well as in Mexico, where production is centered in the arid state of Yucatán. It is possible to grow henequén in dry, limestone soil where almost any other crop is impossible, and the fields receive only an occasional clearing of brush and weeds. The plants do not produce until the fifth to seventh year, but then continue to yield for ten to twenty years. Heavier rainfall in Cuba speeds up the cycle somewhat.

El Salvador produces a fiber similar to henequén, known as "Salvador sisal" *(A. letonae).* It is often used in place of jute for sacks to ship coffee and other staples. With the serious shortage of jute from India, this Salvador "henequén" is filling a definite need. About three-fourths of it is processed in El Salvador's bag factory, partly for use elsewhere in Central America.

Both sisal and henequén are now processed by means of the same large decorticating machines used in processing Manila fiber. These machines scrape away the pulp, water, and waste material from the fleshy leaves, leaving the clean fiber (3 to 4 per cent of the leaf), which is then dried either in the sun for a day or so or by means of mechanical driers. Superior grades are usually baled separately for the market. Growers in Mexico are doing their utmost to avoid waste. In contrast to other fibers that grow in Latin America, little can be done to increase production quickly, because the plants are so slow-growing. Henequén fiber is used chiefly in the manufacture of twine for binding sheaves of wheat, oats, and other grain crops. Mexico's annual production is about 500,000 bales, of which almost one-third is employed locally in Yucatán. Surplus quantities are principally absorbed by the United States.

Free-Lance Photographers Guild

In the same family are found a number of other economically important plants, including the following:

Agave cantala (source of "Java cantala" or "Philippine maguey" fiber)

Agave lophantha poselgeri (source of "Tula istle" fiber)

Agave funkiana (source of "Jaumave istle" fiber)

Furcraea gigantea (source of "Mauritius hemp" or "piteira" fiber)

Furcraea macrophylla (source of "fique" fiber)

Furcraea cabuya and *F. cabuya integra* (source of "cabuya" fiber)

The fiber known as "Palma istle" is obtained from the plant *Samuela carnerosana,* which is closely related to the yuccas. This plant grows wild in the semiarid regions of north-central Mexico. Exports to the United States

Hu Watson from Gendreau, N. Y.

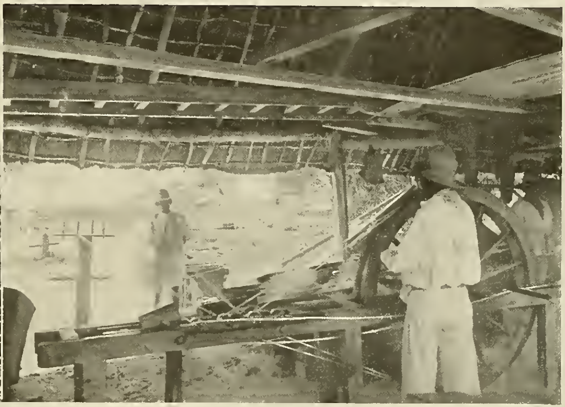
▲ ONLY ONE-THIRD of Mexico's henequén is used locally in Yucatán, the surplus being absorbed principally by the United States

➤ THE LIGHT YELLOW FIBERS, removed from the leaves, are set out to dry on iron racks

◂ **Fiber cultivation** expands in the Americas: Mexicans in the state of Sonora taking up henequén plants for transplanting in another field. Shortages necessitate conservation measures. Wild plants are apt to be killed off by fiber gatherers; a long-term policy of cultivation is prescribed

▾ **Rope** is sometimes spun on a simple machine in Yucatán like that shown below. Note the frames for receiving the rope

▴ **Sisal**, related to the centuryplant, is cultivated in orderly rows and harvested annually. A narrow gauge railway aids in gathering the crop on this plantation near Izamal, on the flat peninsula of Yucatán



A.M.N.H. photos by Frank M. Chapman

have increased substantially following favorable prices caused by war demands. Countless small farmers collect and process it by hand. The fiber is obtained from the young leaves, which form the central bud or cogollo. These leaves are collected and are then steamed for about 12 hours to soften the pulp, which is scraped away by drawing the leaves under a knife pressed against a block of wood. The fiber is dried in the sun, tied in bundles, and packed into hand-made bales for shipment to market. Palma istle is used principally for cordage purposes and for coarse fabrics.

In Ecuador the raising of *cabuya* promises to become an industry of increasing importance. Originally this fiber was produced on a very small scale by the mountain Indians around Quito, who are reported to have extracted the fiber by placing the leaves on roadways to be crushed by passing carts and automobiles. It is now planned to import decorticating and spinning machinery, and to set up a vocational training center where the natives may be taught modern methods of handling this fiber. The planting of cabuya is now being expanded.

The small capital outlay needed for processing *cabuya* by simple methods makes it most promising as a "cottage industry" which would touch the interests of a large part of the population.

Colombia is speedily developing two other native fibers, fique and pita, which are used extensively for making coffee-bags there. Since this country is second to Brazil in coffee production in the Americas, the manufacture of these fiber sacks is an important industry. Although the fique plant requires about four years for the leaves from which the fiber is obtained to become suitable for harvesting, it may continue to yield annually for up to about 20 years.

In addition to these, Central and South America produce a number of other native hard fibers which are or can be used for twine and rope. Among them are:

Caroa (from *Neoglaziovia variegata*) in Brazil

Gravita (from species of *Ananas* and *Bromelia*) in Brazil

Formio (from *Phormium tenax*) in Uruguay, Argentina, and Chile

Yatay (from *Diplothemium littorale*) in Argentina

Maguey (from species of *Furcraea*) in Peru. The *maguey* fiber of the Philippines is taken from *Agave cantala*.

Bowstring-hemp (from species of *Sansevieria*) widely naturalized and cultivated in Mexico.

These all offer possibilities for immediate use during the war and for future development. In Latin America many of these fibers are actually used for bagging, although, being hard fibers, they are usually too rough for bags that are frequently carried by hand. However, several of these fibers have been combined successfully with jute, particularly in Brazil, where bag-weaving firms are now required by law to mix ten per cent of native fibers with imported jute fibers.

Yatay palms, growing wild abundantly on the rolling plains of Argentina's "Mesopotamia," yield a fiber known as *yatay* or *crin végétal*. This is believed to be an adequate substitute for the true Algerian and Moroccan *crin végétal*, used locally as a mattress-filler and derived from the palm, *Chamaerops humilis*. The United States imported 5,000 tons of the Moroccan product in 1939 to stuff cheap mattresses, cushions, and the linings of automobiles.

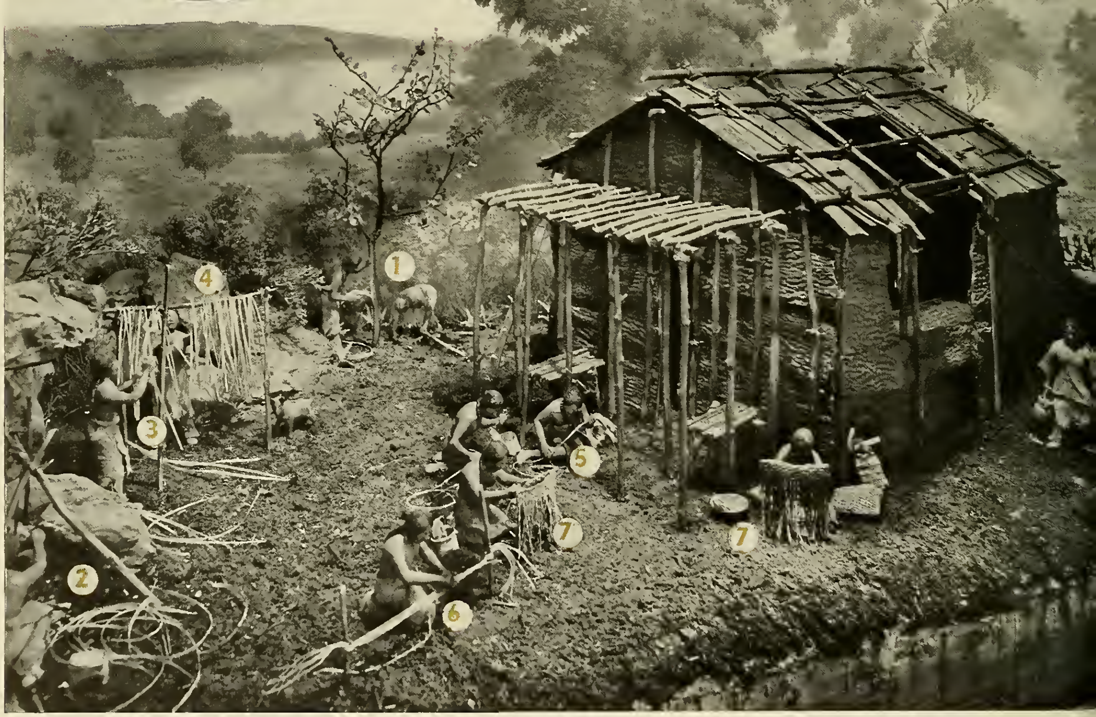
Fiber-growing has become one of the largest industrial undertakings of the Americas in many years, comparing favorably in scale with the program for increasing our rubber production. The wide utilization of wild fibers, however, presents two difficulties: (1) priorities on strategic metals make it difficult to manufacture the machinery for separating the fiber from the rest of the plant, and (2) it takes time to establish a mature crop under cultivation. Wild plants are apt to be killed off by fiber-gatherers. Productive strains, therefore, must be carefully selected and developed in experimental grounds, so that commercial plantations can be established in regions of suitable climate and soil, accessible to a labor supply and market facilities.

Bowstring-hemp is said to be as good as, if not better than, sisal. It is easier to grow commercially, since the plants do not possess the thorns of sisal. Cultivation of it is being encouraged in a section of Ecuador.

Early man must have felt that he had made an important step when he devised a simple bag in which to carry his belongings. Primitive peoples around the world have applied a great deal of time and thought to the use of natural fibers. The Indians in North America employed at least 55 different fiber plants. From hard fibers they manufactured burden-straps, cords, coarse bags, baskets, blankets, headbands, aprons, G-strings, mats, nets, braided and twisted ropes, sandals, and moccasins.

◄THE BASSWOOD TREE, or American Linden, was one of 55 sources of useful fibers known to the American Indians. It grows over a large range in eastern United States

A.M.N.H. *photos*



▲ A MINIATURE GROUP exhibited in the American Museum to show the basswood fiber industry of the Sauk and Fox Indians. (1) Peeling a young tree to get the inner bark. (2) Boiling it in water and wood ashes. (3) Shredding the fiber by drawing it back and forth through a hole in the shoulder blade of an animal. (4) Drying it on a rack. (5) Twisting it on the calf of the leg. (6) Weaving headband of a packstrap. (7) Weaving baskets

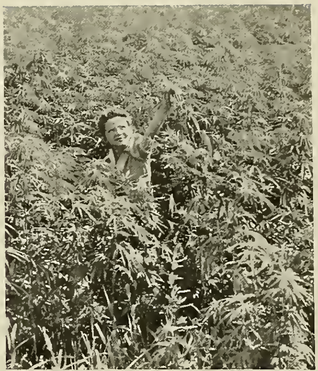
Soft fibers were used by them for making mats, bags, cords, ropes, cloth, fish-nets, wampum belts, burden-straps, fabrics, thin matting, and thread.

In Argentina notable soft fibers are being developed: *ramie* (from *Boehmeria nivea)* and *roselle* (from *Hibiscus sabdariffa,* a plant that has long been cultivated for its fiber throughout the southeast Pacific area). In Brazil, Belgian Congo, and Madagascar *guaxima roxa* (derived from *Urena lobata)* is cultivated and used. *Hibiscus cannabinus* has been utilized by the Russians for the past ten or fifteen years for purposes where jute is usually required. "Colorado River Hemp," produced by the plant *Sesbania macrocarpa,* yields a strong bast fiber that was used by the American Indians.

A multitude of inventions has carried modern man into a world that could scarcely have been imagined a century ago, but the age-old need of a piece of cord with which to tie something is just as urgent as ever. And in a time of crisis we turn back through the pages of Nature's ample catalogue for a solution. Some of the plants the Indians used could be used again. Botanical science will discover and adapt new ones. Meanwhile the economy of thousands of people will be greatly altered in readjustment to an industry which is important in connection with every cup of coffee you drink and every yard of cotton cloth you wear.

Look, for instance, at the position of jute (*Corchorus olitorius* and *C. capsularis*) in human economy. Few Americans know what it is or where it grows. Yet it is perhaps the most important of all the soft fibers, and hundreds of millions of gunnysack bags are made of it every year to handle grain, cotton, coffee, sugar, and other products. "A total elimination of the supply of jute bags," states H. T. Edwards, "would require a general reorganization of the present methods of handling and transporting many of the world's most important raw materials."

India alone produces large commercial quantities of jute. There are numerous regions in the Western Hemisphere where climate and soil are favorable to the raising of jute. Argentina has recently planted extra acres, and it is likewise being culti-



Acme photo

▲ **HEMP**, **the source of the drug marijuana, was grown extensively in pre-Revolutionary days for cordage. But hemp-rigged Yankee ships brought back cheaper fibers from the Far East, and the industry collapsed. Emergency production has now been begun**

G. W. Ackerman Extension Service, U. S. Dept. Agriculture

▲ FLAX in Oregon. Although it is historically the most important plant fiber, flax has not been cultivated extensively for linen thread and cloth in the United States in recent decades. However, the small industry has more than doubled its acreage in the last few years

Philip D. Gendreau, N. Y.

◀ A BUNDLE of flax from which Irish linen is made: a fiber of exceptional quality that is shipped all over the world and mixed with native flax to improve the quality

Philip D. Gendreau, N. Y.

▲ COTTON is one of the most critical plant products in the United States today. Each soldier in our Army is estimated to need 120 yards of cotton cloth per year. More important, cotton provides smokeless powder for rifle ammunition and numerous other strategic products

vated in the Amazon valley, whose vast flood-plain is said to be almost ideal for the growing of this fiber. But the lack of a machine to clean the fiber and the relatively high cost of native labor to do the work impose a serious handicap.

A possible substitute for jute in the Americas is the plant called *malva, malva blanca,* or *guaxima roxa (Urena lobata).* This plant is widespread in tropical America, and bags made from it are claimed to be superior in some respects to jute bags. An experimental farm for its growth has been set up in Cuba, also a factory which can make 6,000,000 bags a year. The industry is expected to employ many Cubans in the field.

In the long history of plant fibers, flax and hemp have been used most universally for ropes and other cordage products up to the beginning of the nineteenth century.

Flax *(Linum usitatissimum)* is typically a product of temperate regions and has been cultivated in cool, moist areas in many lands from Biblical times to the present day. In recent years, however, extensive production has been confined chiefly to Russia and the Baltic states. Flax provides us with linen thread, linen fabrics, fishlines, and other products which require both softness and strength.

At one time almost out of cultivation in the United States, fiber flax is now staging a comeback, thanks largely to improved methods of disease control and the utilization of modern machinery. Most of our flax, however, is of a different variety, grown for the production of linseed oil. Its fiber is not suited for spinning into fabrics, but only as a paper material. Cigarette papers, formerly made principally from old linen rags, are now being made from flax straw.

Retting, the first step in processing flax fiber, is essentially the same today as it was in Biblical times, but modern machinery has been developed for use in later stages. The stems, first dew-retted or soaked in water, are dried and passed between or under rollers. The broken straw is then scutched with machines to remove the broken woody portions and outer bark. In the mill, the short fibers (called tow) are combed out from the longer strands (called line).

It will be a long time before the Western Hemisphere will approach self-sufficiency in this strategic fiber. Fiber flax is more difficult to raise than seed flax (for linseed oil), and the Americas have depended almost entirely on Europe for this fiber. However, the small United States industry has more than doubled its fiber-flax acreage in the last few years.

Another of the most important soft fibers, or bast fibers, is hemp *(Cannabis sativa)*, not to be confused with "Manila hemp."* Hemp is one of the oldest of man's crops. The Chinese were taught to cultivate it by their emperor Shen Nung more than 4500 years ago. The early Greek historian and traveler, Herodotus, spoke of hemp as being used by the Thracians and Scythians, and favorably compared their hempen garments to linen for fineness. Yet hemp seems to have been unknown in Western Europe until the beginning of the Christian era. It was grown in France during the Middle Ages, primarily for its seeds, which were used as food.

A.M.N.H. photo

➤ UNSUSPECTED TREASURES are found in the commonplace things of Nature. Scarcity of kapok, the buoyant fiber used in life preservers, has forced us to look elsewhere in Nature's catalogue. The homely milkweed is found to be a good substitute. Much floss was harvested in Michigan last year

Free-Lance Photographers Guild

▲ CATTAIL FLOSS also has many of the qualities of kapok. It is useful in life belts and floats, heat and sound insulators, and as filling for cushions

In this day of ration-books and priorities, we are apt to think that this is the first time people have had to work out production problems. The colonists who came over in the "Mayflower," however, realized they would have to grow their own rope material and brought several sacks of hemp seed with them to America. Much of the homespun worn by the pioneers who pushed westward across our unsettled continent was of hemp. It was a flourishing crop for many years along our Atlantic coast, but in a sense it brought its own downfall. The hemp-rigged Yankee clipper ships, sailing the seven seas, brought back cheaper fibers from the Far East. Unable to meet the competition after the Civil War, hemp production dwindled.

Continued on page 142

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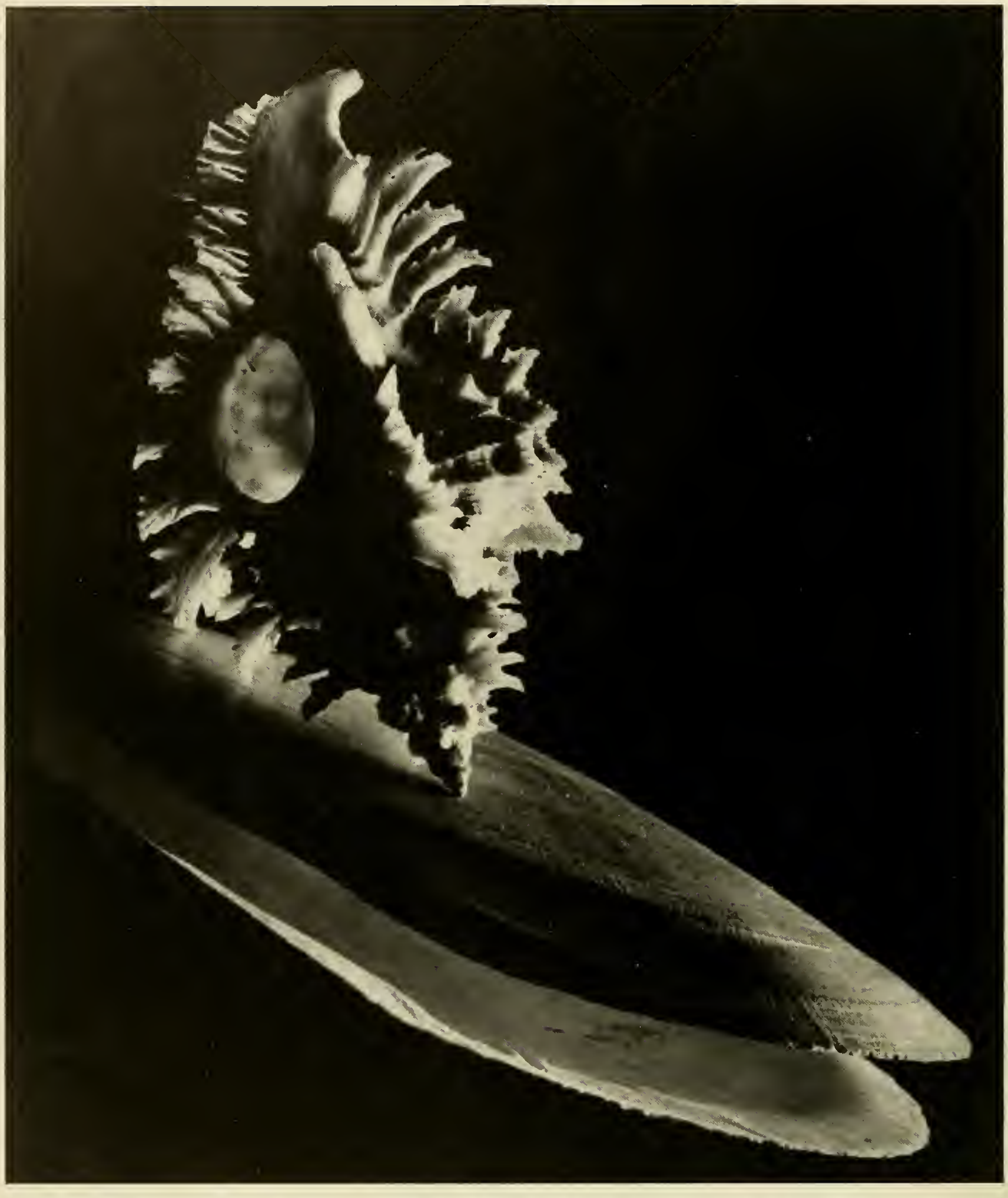
*The word "hemp" is also applied erroneously to sunn *(Crotalaria juncea)*, an East Indian plant of the pea family producing a rope and bag fiber lighter and stronger than jute; to New Zealand flax (*Phormium tenax*); and to sisal (*Agave sisalana*).



East meets West in shell sculpture: a study in contrasts. The Branched Murex (*Murex ramosus*) of the South Seas and the Indian Ocean, ornate with branching spines, almost Gothic in its shelly architecture, is shown in close juxtaposition with the Puritan simplicity of the edible Deep Sea Scallop (*Pecten magellanicus*) protected by streamlined paired shells, of purely utilitarian aspect.

The *Murex* belongs to a large family of coiled sea snails, many of which are noted for their elaborate spiny ornamentation. They include the species from which the ancient Tyrians extracted their famous purple dye, which afterwards became the royal purple of the Roman emperors.

In contrast to this almost grotesquely sculptured creature, the plain valves of the scallop waste no superfluous shelly material to enclose their soft-bodied inhabitant. The scallop is one of the most active of mollusks. Aided by its powerful muscle and an elastic ligament in its hinge, it alternately and rhythmically opens and closes its shells with spasmodic rapidity, shooting out a stream of water from between them, thus propelling itself in irregular flight through the sea depths.

RANDOM *Shells*

Descriptions by
ROY WALDO MINER

Photographs by
RUTH BERNHARD

A Study in Shell Photography

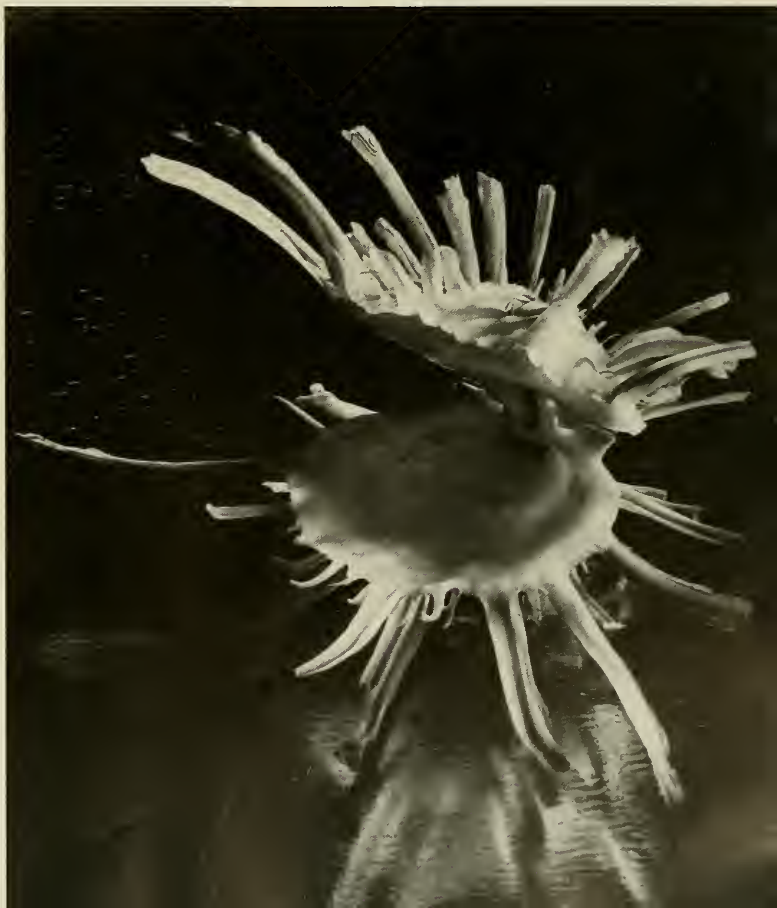
THE soft-bodied animal known as a mollusk acquired the habit of manufacturing carbonate-of-lime to form a protective shell at a very early age in the earth's history. This faculty was already well developed at the beginning of the Cambrian Era, for the rocks of that time contain abundant fossils of mollusk shells buried more than 600,000,000 years ago. Doubtless, this shell-forming habit accounts for the fact that so many species of mollusks have survived extinction from their enemies to the present time. In fact, more species of mollusks are in existence today than of any other group of animals except insects, about 90,000 species having been recorded by scientists.

Since the mollusk shell is of hard substance, and the animal outgrows it, enlargement must take place by addition to its margin to keep pace with the tenant's requirements. This function is performed by the soft mantle, a thin membrane that encloses the entire creature. Most of the shell enlargement is due to lime secreted by the relatively thick edge of this structure.

The shell, therefore, is actually a record of the mollusk's past life and an expression of all its activities. The periodic cessations of growth are marked by concentric lines representing the edge of the shell's aperture each time that growth stopped. Flaring lip-spines, due to more or less frequent exuberances of shell formation just before certain of these waiting periods, are completely preserved, when growth is resumed, as conspicuous sculptural features. Colored pigments deposited by special glands at the lip-margin remain, as the mollusk shell grows, to form the elements of a beautiful pattern on each whorl.

Thus, shells may be beautiful or they may be grotesque, but they are always interesting. Even when picked at random from a collection they are sure to fascinate both student and artist, whether the latter be a painter, sculptor, or photographer.

The remarkable and often surprisingly variable forms of shells and the contrasts of light and shade presented by their sculpture are especially irresistible to the skilled camera artist, as illustrated in this series of photographs, so well executed by Miss Bernhard. Incidentally, the pictures provide an opportunity for commenting on some interesting features of the various species of shells which she has selected for portrayal.



➤ A WELL-PROTECTED OYSTER. Not all bivalves (two-shelled mollusks) are devoid of sculpture. The Thorny Oyster (*Spondylus pictorum*) is abundantly equipped with long, flattened spines, curving outward in menacing fashion, gayly colored with rose, orange, and yellow. It inhabits tropic seas, where its rich hues blend with the multicolored setting of the coral reefs.

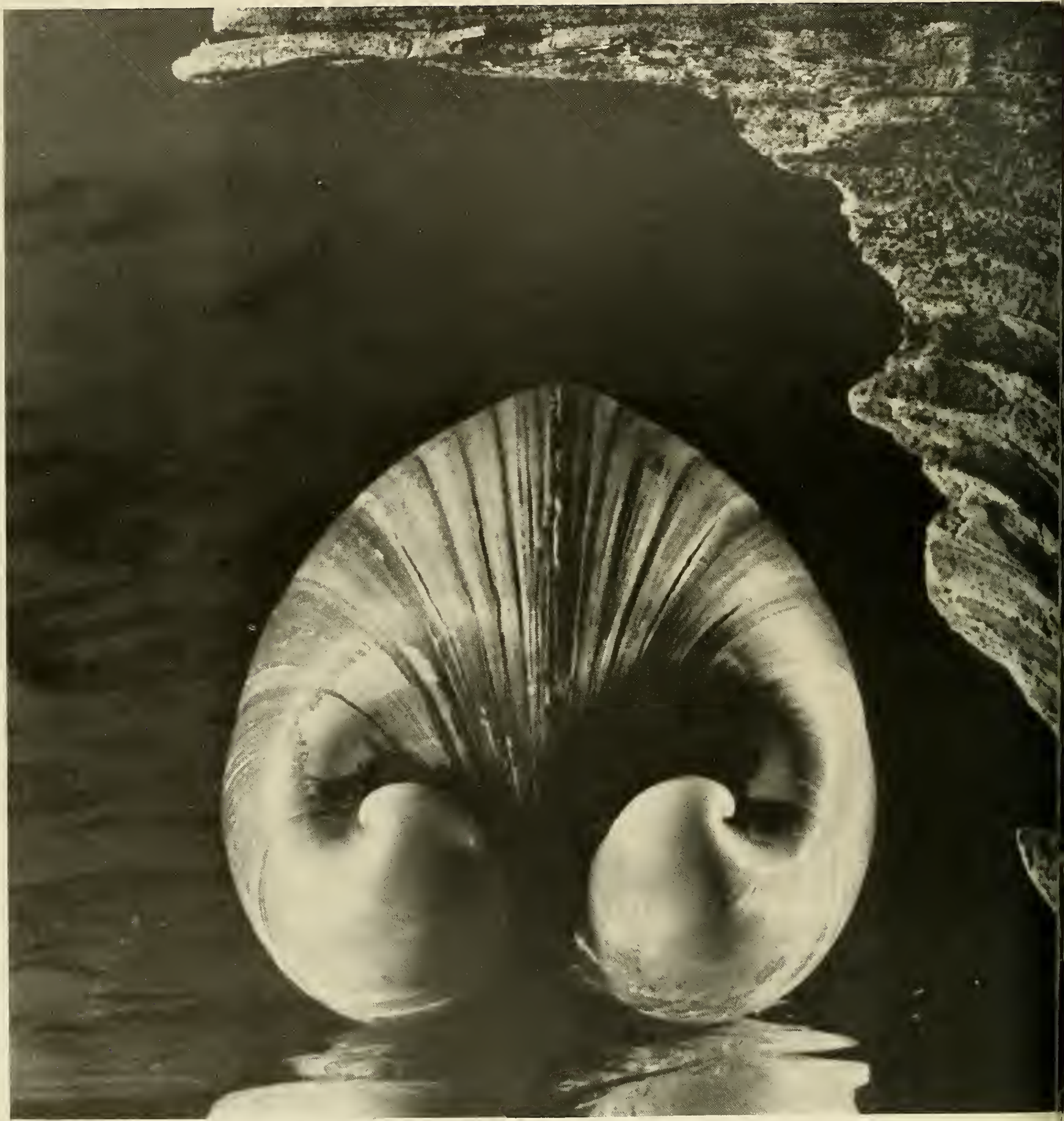
It is usually attached to coral rocks by one of its valves, and thus cannot skip about like the Deep Sea Scallop to avoid its enemies. Hence the need for its formidable armature to repel invaders.

▼ A STUDY IN SYMMETRY. The remarkable Heart Cockle of the Mediterranean Sea (*Isocardia cor*) is a bivalve with shells that display a most unusual symmetry. The umbos of the two shells match each other perfectly as they curve to their peaks in a faultless spiral, and as seen here they present a striking heart-shaped figure, from which this shell derives its name.

About five species are known to exist, exclusive of many fossil forms. They range from Britain as far as China and Japan. Each shell about fits the palm of the hand.

➤ VERSATILE SNAILS. The Swamp Apple Snail (*Ampullaria paludosa*) is so called because it is about the size, shape, and color of a small green apple. It inhabits the swampy regions about the tributaries of the St. John's River in Florida, while other members of the family are found in fresh waters of the tropics in both the Old and New Worlds.

These mollusks are quite amphibious, for they breathe by means of gills when submerged. ➤



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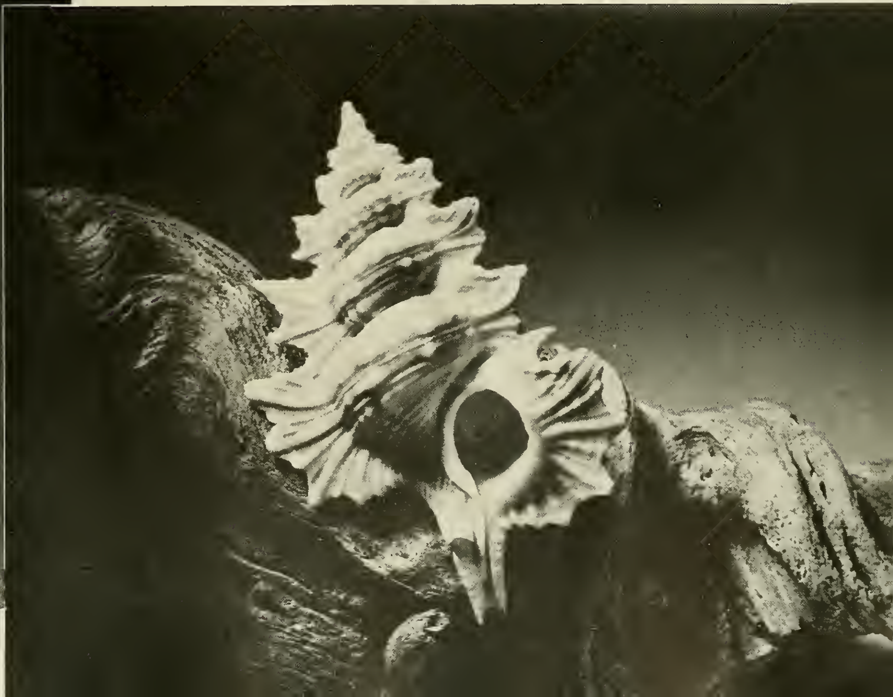


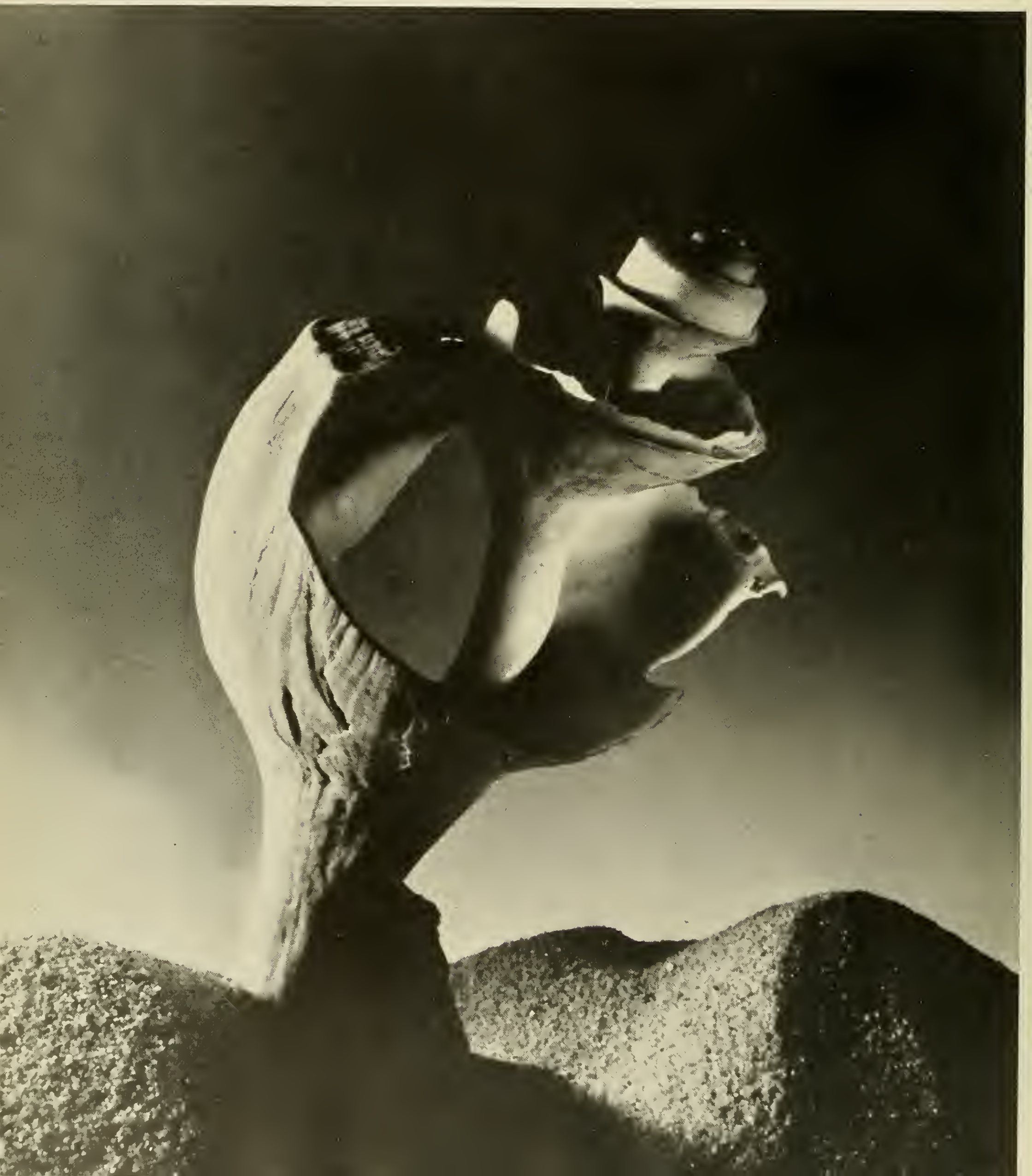
▼ A DANDY AMONG MUREX SHELLS. The Frilled Murex (*Murex beaui*) is one of the most variable shells of this group. When it occurs in shallow or muddy waters it is quite plain, without any flaring adornments. But in clear, deeper waters, especially on rocky bottoms, it dresses up in quite a dandified fashion, with three rows of leaflike frills extending from spire-tip to body whorl. These increase successively in size until they fan out around the aperture of the shell like a great butterfly bow. Each frill is adorned with radiating ribs — expanded continuations of the finer riblets with which the turns of the revolving spire are sculptured.

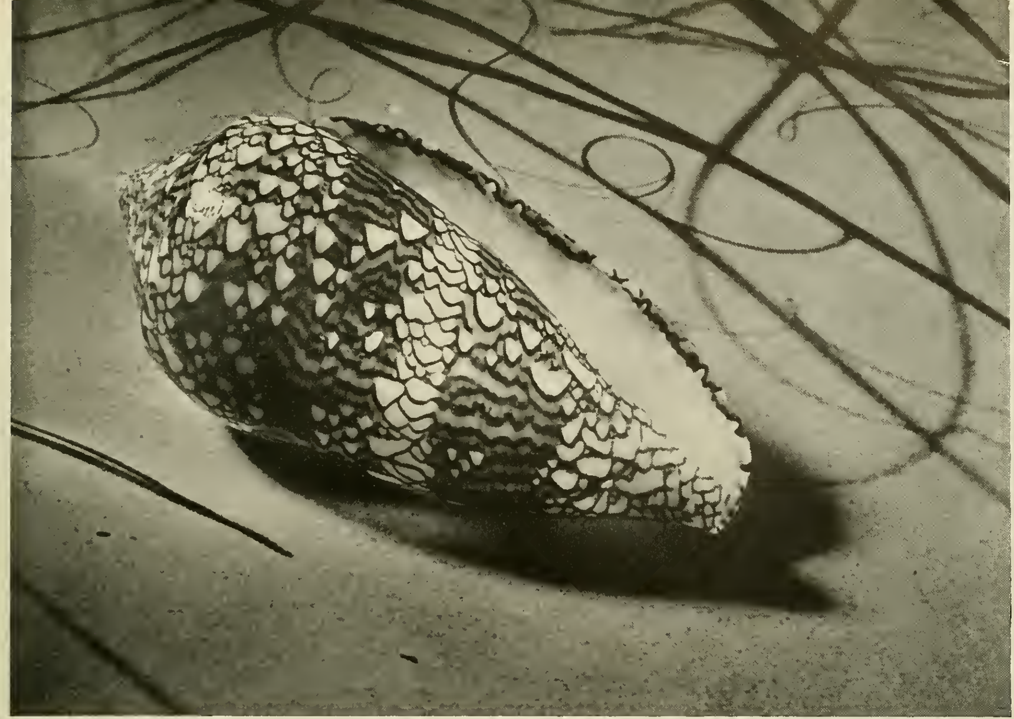
This Murex occurs throughout the West Indies from Florida to the Gulf of Mexico.

▼ INTERNAL ARCHITECTURE. A shell of the Giant Whelk (*Busycon canaliculatum*) has been broken open to show its interior, and, incidentally, to reveal the story of the shell growth. When newly hatched, the whelk possessed only the little knoblike shell which still shows at the summit of the spire. As the animal grew, it built the shell larger in a spiral course to fit its growing body. The outer curve of the spiral formed the expanding outer shell surface. The inner side was squeezed compactly, resulting in the more or less solid columella, or central spiral stem, the main mechanical support of the shell. This is shown clearly in the photograph.

This is one of the largest mollusks found along our Atlantic Coast. It devours oysters and other mollusks, boring a neat, round hole through their shells with the rasplike teeth of its proboscis and sucking out the soft parts.

The Indians formerly carved the columella of this species into white beads for their wampum belts.



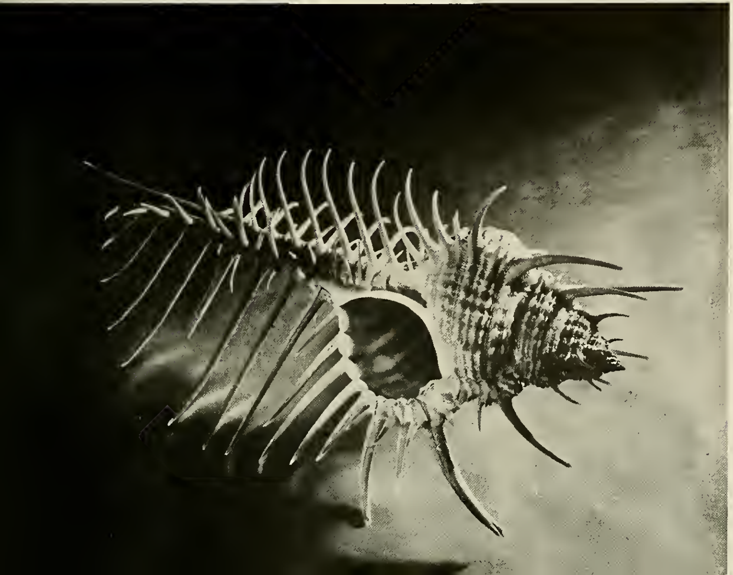


▲ A PRINCE AMONG SHELLS. The cones may be considered the royal family of shells. The Cloth-of-Gold Cone (*Conus textile*), shown here, is dressed in princely garments, richly patterned in chestnut brown, gold, and white, in contrasting zigzag stripes crossed by broad revolving bands composed of pure white mosaic triangles outlined in deep brown.

Four hundred species of cones are found in tropical seas throughout the world, but especially in the Pacific Ocean and the Far East. Most of these exhibit gorgeously contrasting patterns, adding greatly to the colorful reefs where they are found. They prey voraciously upon other mollusks by means of their cutting teeth.

One conical tooth, in particular, is equipped with a poison gland, and is capable of dealing a vicious wound to the careless hand that picks it up.

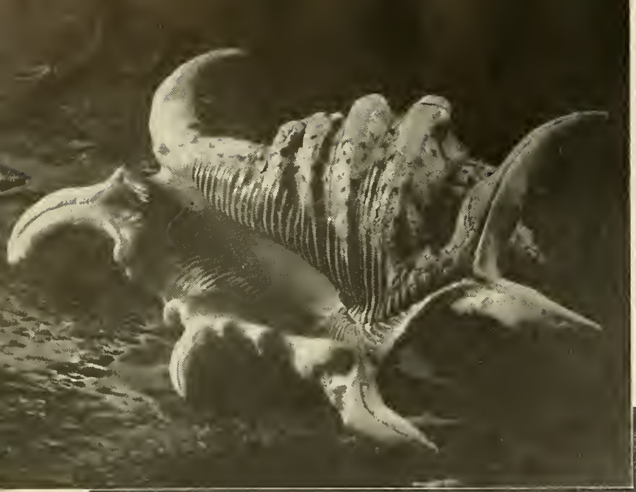
These shells are much esteemed by natives of the South Seas, one species being used for money, while another is reserved as a symbol of chieftainship. The rarest of all, the "Glory of the Sea" (*Conus gloria-maris*), is much sought after by collectors. Not more than twelve specimens of this shell are known in collections, of which the American Museum of Natural History possesses two.



◄ FOR A SEA-GODDESS'S TRESSES. Venus's Comb (*Murex tenuispina*) is an appropriate name for this species, after the goddess who was born of the ocean foam. The graceful shell entitles it to be called the most beautiful of the Murices. The slender, tapering canal is equipped with three rows of long, curving spines, alternating with three other rows of short ones, all arranged in parallel series, strongly suggesting a most unusual type of comb.

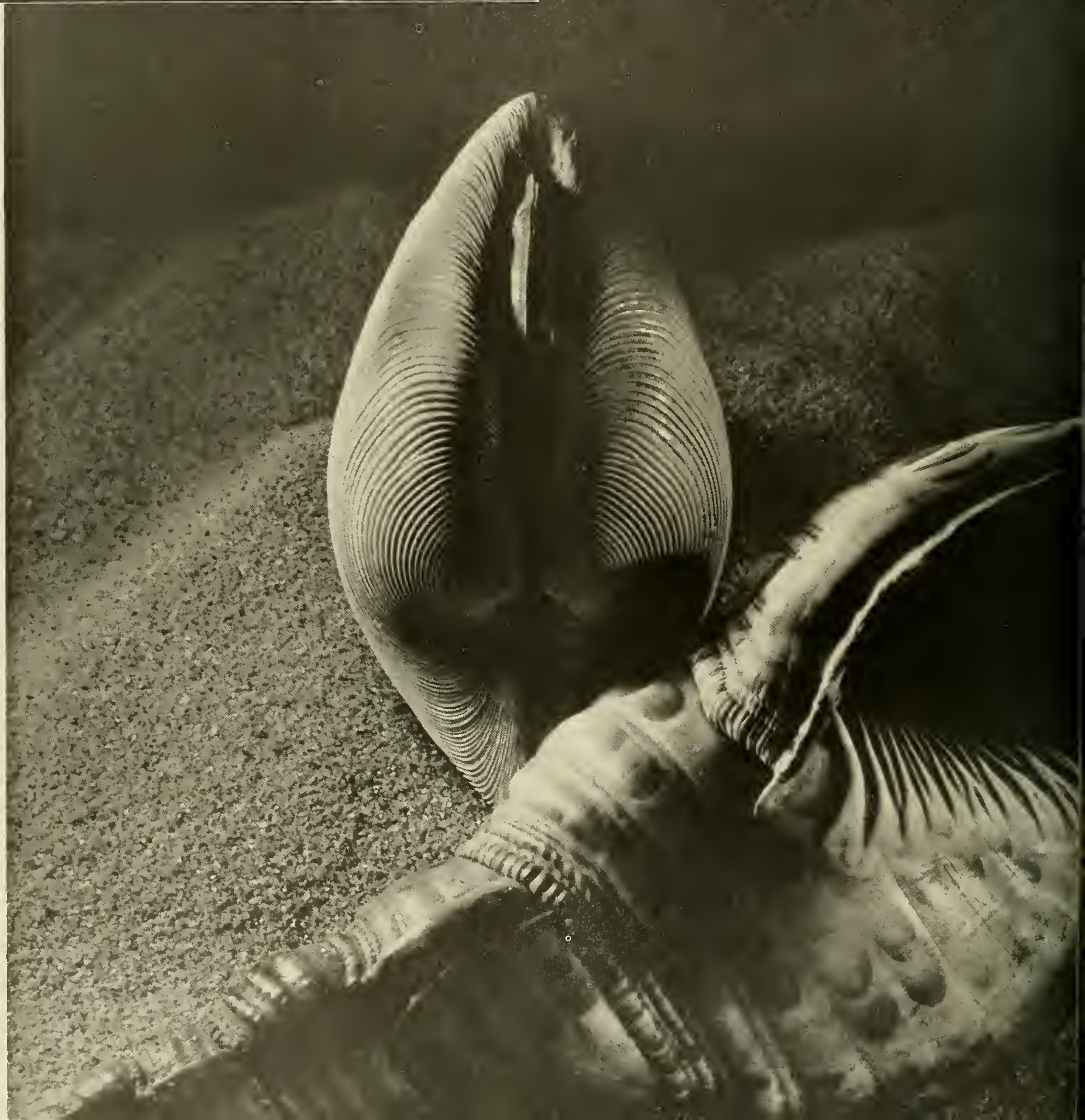
The conical spire, at the right, is adorned with alternating rows of large and small finely set ribs. The shell aperture or "mouth" is a perfectly arched, lenticular opening. The color of the living shell is soft brown, often tinged with bluish.

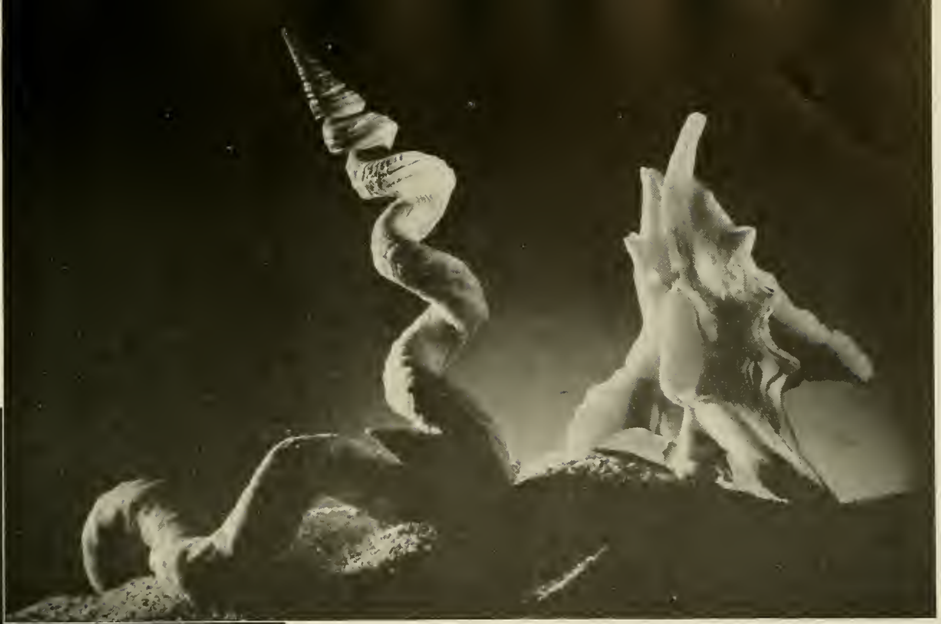
This mollusk lives in the Indian Ocean, ranging also to Japan and Australia.



◀ THE GROTESQUE IN SHELLS. That shells may be weird as well as beautiful is shown by the Spider Shell (*Pterocera rugosa*). First cousin of the West Indian Queen Conch (*Strombus gigas*), the adult shell, instead of developing the widely flaring lip characteristic of the latter species, expends the momentum of its shell-forming energy in producing the six long, curving and tapering spines, which sprawl in various directions from the lip margin. These spines are hollow when first formed, but they finally become solidly filled with shell material. The young shell can hardly be recognized as the same species as the adult, for it has a perfectly ordinary smooth lip. Later, flat budding projections appear, which develop into the extraordinary adult condition.

The Spider Shells are found in the Pacific and Indian Oceans.





▲ A WEIRD CONFERENCE FROM COAST TO COAST. Here, two American shells, one from the Atlantic Coast the other from California, are apparently trying to impress each other with their relative grotesqueness.

At the left, the common Worm Shell (*Vermicularia spirata*), which looks like a worm but is a mollusk nevertheless, started off in life as a perfectly respectable sea snail, as may be seen from the close spiral of the coils at its tip. Then, apparently, its shell-building activities got out of control, for in the latter part of its existence the shell wandered aimlessly in loose coils all over the sea bottom. It is often found, with others of its kind, in great coiling masses, perhaps for mutual protection.

At the right, the Three-cornered Trophon (*Trophon triangulatus*), from deep water off the California coast, displays its fragile, spiny shell. The photographer has posed it with its spire downward, buried in the sand, and with its round aperture facing the Worm Shell, doubtless to enhance its weird effect. Its delicate drab or soft brown coloration and exquisite sculpture make it one of the most attractive of sea shells. It is quite unusual to get a perfect specimen, because of its great fragility.

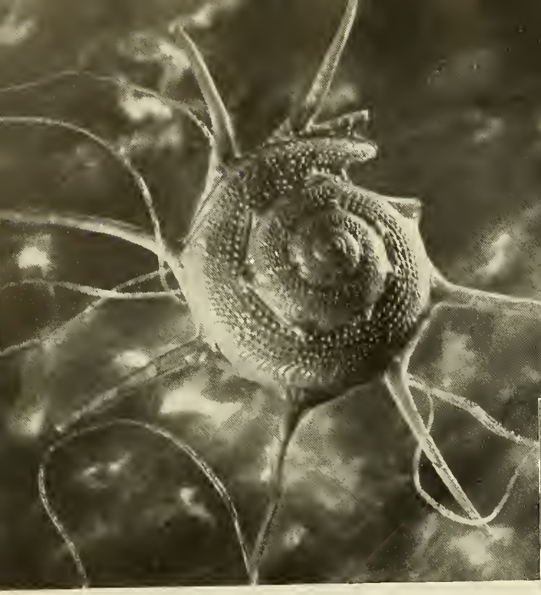
◀ SEA SNAIL AND BIVALVE. These shells typify two of the main classes of mollusks, the Pelecypoda, or bivalves, and the Gastropoda, or snails.

The Pelecypoda have two nearly equal shells, hinged together at the top, while the Gastropoda possess a single, spirally coiled shell.

They are represented here, respectively, by the common Hard Shell Clam (*Venus mercenaria*), familiar on our Atlantic Coast as one of our most welcome table delicacies, and Triton's Trumpet Shell (*Triton tritonis*) of the South Seas and East Indies.

Triton's Trumpet is beautifully marked with brown, yellow, purple, and red arranged like lines of overlapping scales along the whorls. The Polynesian natives use it for a pot, the horny operculum (not present here) serving as a lid. The spout is formed by the curving canal which terminates the shell aperture at its base. Sometimes a hole is made near the apex of the spire, and the shell can then be blown like a trumpet. It is one of the largest of the sea snails, often reaching a length of sixteen inches.

The Hard Shell Clam, common though it is, possesses a special beauty of its own, because of the graceful, symmetrically equal shells, with their evenly developed concentric growth lines. The closely locking internal hinge and two powerful muscles keep the shells tightly closed against the opposing action of the membranous elastic ligament, which causes the shells to open when the muscles are relaxed. This ligament shows conspicuously in the photograph, as an external feature at the upper part of the shell junction.

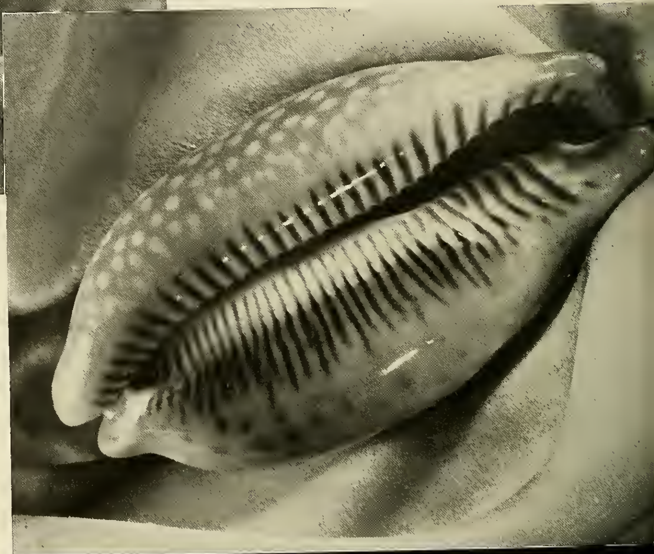


◀ **The Japanese star shell.** This fragile Star Shell (*Astralium triumphans*) of the Sea of Japan is phantom-like in its delicate spiral symmetry. Around the flattened spire and body whorl radiate slender tapering spines. The shell is relatively common within its region. It is about two inches or more in diameter. While this particular species is of comparatively limited range, other members of the genus *Astralium* are widespread in tropic seas, some occurring in the West Indies. Many are characterized by a tendency to produce more or less flattened spires and radiating spines or tubercles. The filaments in the photograph are not parts of the shell, but are threadlike seaweeds.

➤ **The venus shell.** This Queen of Beauty among shells belongs among those devoted to the goddess of loveliness. For it is one of the Cowries, included in the genus *Cypraea,* a name derived from the Island of Cyprus, sacred to Venus as her first home. The *Cypraeas* have been much sought after by collectors. Hundreds of species are known from tropical seas, all characterized by the graceful oval shape, beautifully patterned coloration, and the high natural polish of their external surface.

The species shown here, the Spotted Cowry of the West Indies (*Cypraea exanthema*), is covered with round pale spots on a background clouded with chestnut verging into bluish drab. Other species in the South Seas are bright orange, or are banded and mottled with rich hues of purple, brown, blue, or flesh color.

The living animal is even more brilliantly decked out than its dwelling, for the mantlefold extending over the outside of the shell is gorgeously colored and patterned. This mantle is responsible for the beautifully polished surface for which the *Cypraeas* are noted.

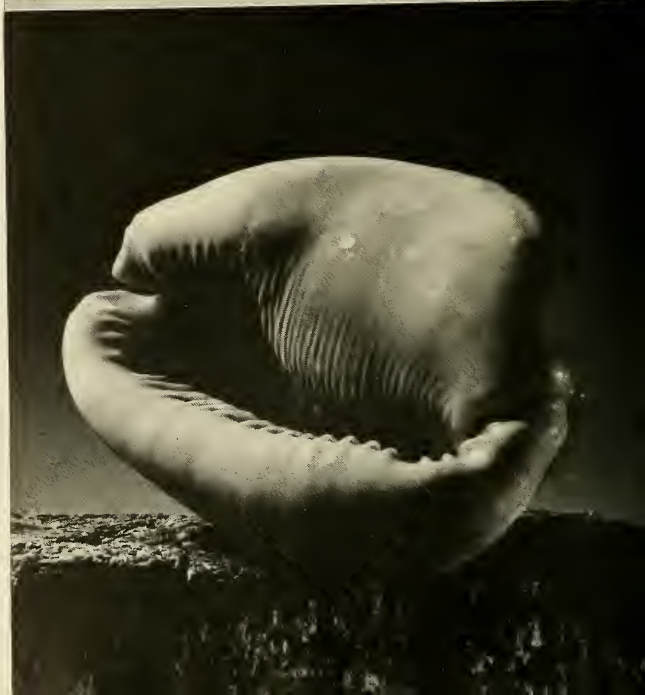


➤ **Bull's mouth** (*Cassis rufa*). The aperture of the Red Helmet Shell or Bull's Mouth suggests the latter name because of the flaring red "upper lip" and rolling lower one. The slitlike orifice with wrinkled modeling, narrowed in the center and slightly expanded at the ends, is indeed very suggestive of a bovine mouth!

The orange-red spire, when standing with the aperture downward, is helmet-shaped. This is one of the commercial cameo shells often seen carved into bas relief by skillful artisans.

This shell is well known as a household ornament, often used as a doorstop. It is sometimes equipped with an electric light for use as a table lamp, the wonderful coloration of the shell being brought out by the light shining through it.

This species is common in the Indian Ocean, especially off the coast of Zanzibar.



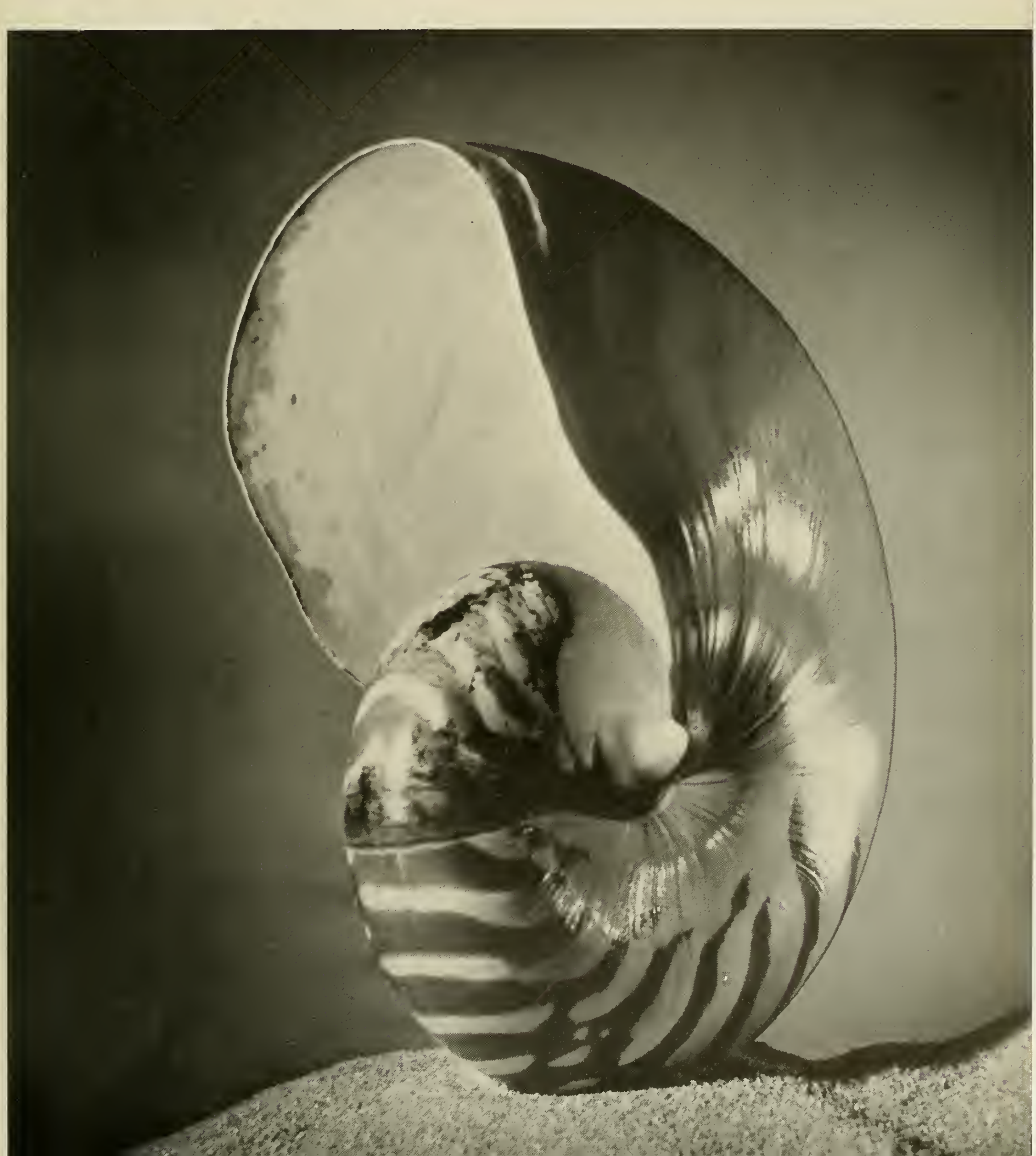
▼ **A CASTLE OF PEARL.** The Chambered Nautilus shell (*Nautilus pompilius*), famed by poets and artists, sought after by collectors and merchants of mother-of-pearl, is the habitation of a noble mollusk of unbelievably ancient lineage, reaching far back into geologic times. Scientists call it a "living fossil," because its primitive make-up has persisted to the present time with little change.

The graceful spiral is conspicuously patterned with reddish brown stripes, alternating with cream color. There is a large black blotch at the center, near the shell-opening.

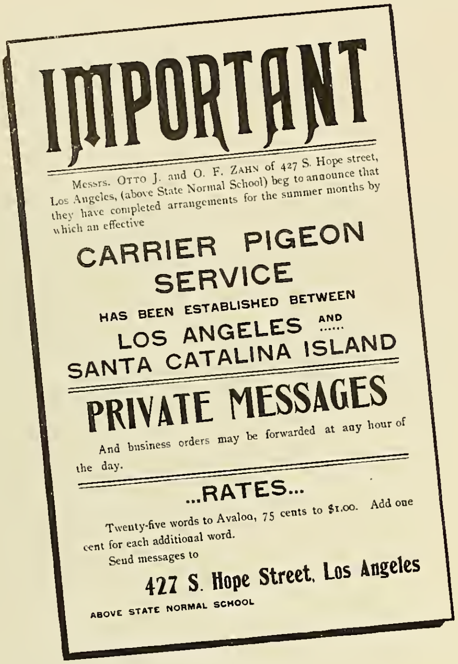
The lining, and, in fact, the entire thickness of the shell beneath the thin colored surface, is composed of iridescent mother-of-pearl. The interior of the coil is divided into a succession of chambers by concave pearly partitions, gradually increasing in size from the central chamber outward.

The animal, a relative of the squids and octopuses, lives in the outer chamber, and, when grown too large for it, seals up its former home and constructs a new one.

It is particularly abundant near the Philippines, Fiji, New Caledonia, and neighboring islands.



America's first *AIR*



IMPORTANT

Messrs. OTTO J. and O. F. ZAHN of 427 S. Hope street, Los Angeles, (above State Normal School) beg to announce that they have completed arrangements for the summer months by which an effective

CARRIER PIGEON SERVICE

HAS BEEN ESTABLISHED BETWEEN

LOS ANGELES AND SANTA CATALINA ISLAND

PRIVATE MESSAGES

And business orders may be forwarded at any hour of the day.

...RATES...

Twenty-five words to Avaloo, 75 cents to $1.00. Add one cent for each additional word.

Send messages to

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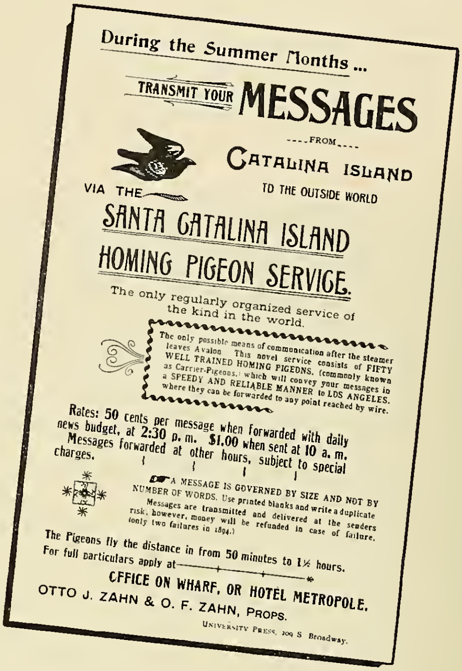

During the Summer Months ...

TRANSMIT YOUR MESSAGES

----FROM----

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TO THE OUTSIDE WORLD

VIA THE

SANTA CATALINA ISLAND HOMING PIGEON SERVICE.

The only regularly organized service of the kind in the world.

The only possible means of communication after the steamer leaves Avalon This novel service consists of FIFTY WELL TRAINED HOMING PIGEONS, (commonly known as Carrier-Pigeons,) which will convey your messages in a SPEEDY AND RELIABLE MANNER to LOS ANGELES, where they can be forwarded to any point reached by wire.

Rates: 50 cents per message when forwarded with daily news budget, at 2:30 p. m. $1.00 when sent at 10 a. m. Messages forwarded at other hours, subject to special charges.

☞ A MESSAGE IS GOVERNED BY SIZE AND NOT BY NUMBER OF WORDS. Use printed blanks and write a duplicate. Messages are transmitted and delivered at the senders risk, however, money will be refunded in case of failure. (only two failures in 1894.)

The Pigeons fly the distance in from 50 minutes to 1½ hours.

For full particulars apply at

CFFICE ON WHARF, OR HOTEL METROPOLE.

OTTO J. ZAHN & O. F. ZAHN, PROPS.

UNIVERSITY PRESS, 209 S Broadway.

By CURTIS *ZAHN*

TODAY, as for centuries, homing pigeons are carrying messages into areas where all other means of communication fail. As far back as Caesar's time they delivered messages which helped change the outcome of victory. Even in the United States, the late James Gordon Bennett was rumored to have utilized winged messengers in building his journalistic empire.

What may have been history's most highly organized pigeon "telegraph service" came and went almost without comment during the gay nineties in California. It was the first regular "air-mail" schedule of any kind.

The 48-mile route was from Catalina Island to Los Angeles, with half the flight over open sea, making meticulous training and breeding of the birds necessary. The service operated on a rigid timetable, leaving the island resort of Avalon at 2·00 P.M. daily and arriving at the loft in Los Angeles about an hour later. Hundreds of letters were delivered, regardless of "flying conditions," and during the three seasons it operated, only two failures are reported.

The enterprise was formally opened in 1894. At that time Catalina was a fashionable resort, visited by tourists and sport-fishermen from all over the United States, but there was no organized communication between the island and the mainland. Wireless was yet to be invented, and the cost of laying a cable was prohibitive. The writer's father and uncle, both pigeon-fanciers and amateur ornithologists, had been experimenting with homer flights, and the idea of a mail service seemed feasible. Their first step was an agreement with Western Union whereby that organization would not attempt to set up a wire service to Avalon as long as the pigeon mail project refrained from competing on other routes where telegraph was established.

Training the birds was as laborious then as it was haphazard. My father and uncle used to carry them in baskets attached to their bicycles and release them from points five, ten, then fifteen miles west of Los Angeles. All of the pigeons would make the trip home eventually, but some loitered and had to be weeded out. On one occasion, the two brothers had ridden almost to the ocean, intending to camp out after releasing the birds. But the homing instinct was supplanted by desire for human companionship, and the birds remained around the campfire until morning.

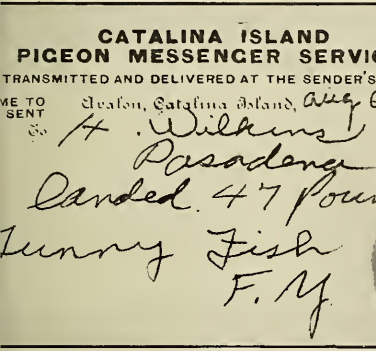
Finally through trading and breeding, enough fast birds were acquired to continue the project, and soon they were being released from steamers at various distances from shore. When the weather was foggy, the birds would climb above it, circle about, and head for home. On one occasion the entire flock lit on the ocean, remained a few moments, and sailed for home. It was later learned that the steamer attendant had forgotten to give them drinking water.

MAIL

Ceiling zero, visibility zero," but the faithful essengers preserved contact with the mainland, ummoning medical aid and carrying the day's ews before the invention of wireless telegraphy

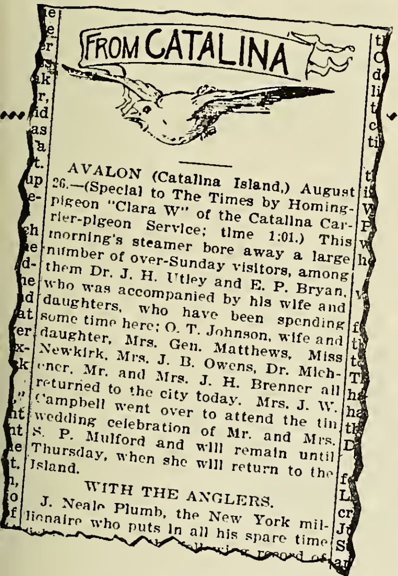
◀ ORLANDO, one of the 50 well-trained homing pigeons that linked Catalina Island with the California Coast

▼ ONE of the actual messages carried by pigeon air mail in the "gay nineties"



CATALINA ISLAND
PIGEON MESSENGER SERVICE
TRANSMITTED AND DELIVERED AT THE SENDER'S RISK

ME TO SENT — Avalon, Catalina Island, Aug 6 1895
To H. Wilkins
Pasadena
Landed 47 Pound
Tunny Fish
F. M.



FROM CATALINA

AVALON (Catalina Island,) August 26.—(Special to The Times by Homing-pigeon "Clara W" of the Catalina Carrier-pigeon Service; time 1:01.) This morning's steamer bore away a large number of over-Sunday visitors, among them Dr. J. H. Utley and E. P. Bryan, who was accompanied by his wife and daughters, who have been spending some time here; O. T. Johnson, wife and daughter, Mrs. Gen. Matthews, Miss Newkirk, Mrs. J. B. Owens, Dr. Michener, Mr. and Mrs. J. H. Brenner all returned to the city today. Mrs. J. W. Campbell went over to attend the tin wedding celebration of Mr. and Mrs. S. P. Mulford and will remain until Thursday, when she will return to the Island.

WITH THE ANGLERS.

J. Neale Plumb, the New York millionaire who puts in all his spare time

◀ A PRESS DISPATCH sent via the Catalina Pigeon Service

Eventually the day came when pigeons could be released from Avalon City and would fly directly toward the mainland. By then the owners had discovered that it was best to release one or two old birds with the beginning pilots. It was also found that young swains are never as domestic as married fathers, and that correct feeding was necessary for maximum efficiency.

There were other hazards, for hawks were numerous and hunting was a popular sport, the hunters often being not overly particular in what they sought. It was because of the Avalon-Los Angeles messenger service that a state law was belatedly passed, making it illegal for gunners to shoot homing pigeons. Even so, many birds came home wounded and still others failed to arrive. It proved necessary to dispatch three birds bearing duplicate messages, in order to ensure arrival of each letter.

Despite unfavorable conditions, the service had immediate success. "Air-Mail" letters on onion-skin paper were collected from a box in front of the old Metropole Hotel. About an hour later—50 minutes was record time—the birds rang the bell in the downtown Los Angeles loft. From there a messenger boy dispatched the message to the recipient's address or had it telegraphed if the destination was remote. The Los Angeles *Times* sent a full column of news daily, and doctors were often summoned for emergency cases by this means.

Once only did the faithful birds fail to start the trip, and once they were held up along the route. On the former occasion all three birds (this number was usually dispatched simultaneously) remained on the island for the afternoon and roosted on the roofs all night. The owners were mystified until the steamer arrived next day bearing news that a freak lightning storm and hurricane had raged through Los Angeles.

The unique service operated until 1898, serving a genuine purpose. Then changes came to the island, and the homing pigeons bowed to Marconi's wireless. The fee of 50¢ to $1.00 per message had scarcely paid the overhead of the enterprise, and my father and uncle went into long-distance racing. Even so, the valiant birds that gave the world its first "air mail" set a pace that today's war birds must exert themselves to excel.

PARICUTIN

UNITED STATES
MEXICO
• PARÍCUTIN

All photographs by the aut

By FREDERICK H. POUGH
Chairman and Curator of Geology and Mineralogy, American Museum of Natural History

On September 29th, 1759, the residents of Jorullo, a small community in the State of Michoacán, Mexico, were alarmed by the sudden eruption of smoke and flames from the bottom of a small gulley. Heavy black mud fell on neighboring buildings, and in a few hours the land was ruined and the houses flattened by the soggy mixture of ashes and rain. Accompanied by earthquakes, the activity rapidly increased, and in a few days the beginnings of the formation of a volcanic cone were apparent. However, no one with geological training visited the scene, and the eyewitness accounts are naturally colored by the ignorance of the writers and by their awe and fright. Not until 1803, long after all activity had died down, was the spot visited by a scientist, Humboldt, and his studies were influenced by his championship of a theory which has long ago been discredited.

Common as such cinder cones are, as evidenced by the many volcanic hills of that region, no repetition of the dramatic events of that morning took place until February 20th of this year. Stories vary, but according to the most convincing, Dionisio Polido,

▼ **NEAR-BY URUAPAN** has gained tourist fame for its inlaid lacquer *bateas,* and for its quiet woodland scenery. Now both may be destroyed by Parícutin's ash, for the lacquer sources are dying under the ash load

▼ **ORCHID PLANTS** may be seen in bloom in the woods through which one approaches the volcano, or they may be bought in the market places for ten centavos, about two cents

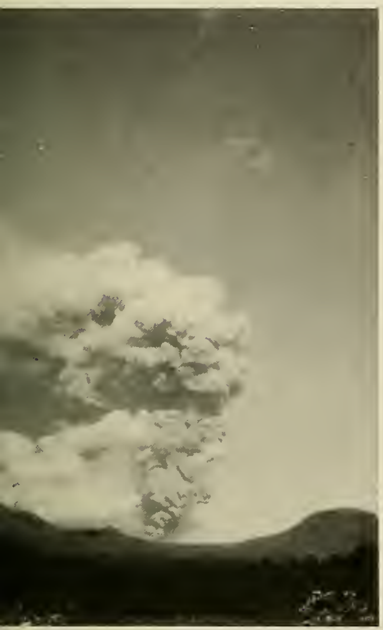
S BORN

Mexico's new 1000-foot peak gives scientist the rare opportunity to study a rapidly growing volcano

a native of the small village of Parícutin, was walking in his cornfield, perhaps estimating his prospects for a good crop with the advent of the June rainy season, when he observed a small fissure from which dust and rumbling sounds were emanating. Frightened by this foreign product of his familiar field, he ran to get his wife, his neighbors, and the priest. On their return from the village two miles away they are reported to have found the beginnings of a small volcano, giving forth loud rumblings, ejecting hot rocks and dust. The inhabitants of the village were considerably alarmed by these events, and reports soon reached the more distant communities of Uruapan, Morelia, and Mexico City. Don Felipe, Mayor of San Juan de Parangaricutiro, notified the governor of the state, and official recognition of the volcano was soon under way.

The now famous cornfield of the unfortunate Polido was strategically situated on the road from Uruapan to Parícutin. Visitors commenced coming as soon as the news reached the larger communities, and the early comers had the pleasure and the unique experience of being able to drive their cars almost to the foot of the rapidly growing cone. Easy chair sight-seeing with considerable traffic congestion on a road never intended for such wear, continued for some weeks, while the volcano piled its hot blocks ever higher.

Early in its career a lava flow appeared, carrying with it the walls of that side of the crater and moving steadily along, sometimes faster, sometimes slower, at about seven feet an hour. The Mexican geologist Ezequiel Ordonez visited the volcano soon after its beginning and watched the progress of the early flow. It described a semicircle around the cone itself, but



◄ On clear days the dust column rises seven miles above the cone and is a spectacular sight from the main Morelia-Uruapan highway. At night its red bursts make a similar beacon to the distant observer

 Some bulbous plants, lilies and Oxalis, have been able to ush their flowers through the one- or two-foot ash beds, for the all of ash during the dry season could not harm the dead foliage f the previous year. However, it will be interesting to see if the lants can long persist under so much extra cover

▼ With the road over which the early tourists drove now deep in ash, the approach must be made by horse and burro, from the town of San Juan de Parangaricutiro, about four miles away. Even the maguey leaves collapsed under the weight of the ash, and all the countryside is gray

stopped before it reached the village of Parícutin. Pushing along tremendous solidified blocks of lava, it formed a jagged and irregular plateau with 50 or 60 foot eminences rising above the 15 to 20 foot general level.

After about three weeks, however, the nature of the eruption changed. The cone began to grow rapidly higher, and vast quantities of ash and cinders were thrown from the crater. The auto road from Uruapan, about 18 miles away, was covered by some of the flow and deluged with ash, making it more difficult to reach the volcano. But still the tourists came, and the cone grew ever higher; and higher yet as they recounted their adventures to their friends and to the press.

Despite the grandeur of the sight, little was said in the American papers about the volcano, and even now few people appreciate the importance of this event. War work has prevented most geologists from visiting the locality, and very few scientists have gone from the United States to observe and record the happenings in this spot in Michoacán. It is to be hoped that it will continue long enough after the war for more geologists to see it; at least that is the hope of the geologists, though the residents of the region would be glad to be rid tomorrow of the growling, fire-spitting, dirty intruder, and Sr. Polido would no doubt far prefer his cornfield and his quiet life.

By the fourth month since its formation the cone had risen to a height of 1000 feet. It seemed to have repaired all the damage caused to its symmetry by the earlier lava flows, re-forming a symmetrical cone about 1000 feet across at the top and about 3000 at the base. Above this towered a tremendous column of black dust, rising over six miles in the air and shedding a shower of coarse and fine particles over an area of many square miles. The fine cinders in Uruapan were thick enough to have been shoveled up into piles in the streets, and to have been swept off the roofs. Even at Morelia, over 100 miles away, wisps of black dust could be seen on the streets, and on clear days the dust column was reported to be visible from the next town.

The visitor who has never seen a volcano in eruption is quite unprepared for the grandeur of the spectacle. The towering cloud by day is awe-inspiring enough, but it is the night view which really puts the finishing touch on the trip. Few, if any, volcanoes, however, can ever give the effect of Parícutin, for here we have a friendly sort of cone with which one can become very familiar without great risk. Only a thousand feet high, it can be viewed in comfort from a distance of not much over a mile. Near-by is a hill, another and now long dead volcano cone, which rises a little higher than Parícutin, from which one can almost look down its throat. The early lava flow is now all covered by many feet of cool ash, and can be walked upon with impunity. The foolhardy can get as close as they like to the cone, walking on the still hot rocks of the early flow. There is no risk except that rare chance of being struck by a bomb. That is such a remote risk that it is not worth considering, unless the rain of stones is very heavy.

The writer, sent to visit the volcano by the Council Fund of the American Museum, considers it a rare privilege to have seen this eruption in all its grandeur, but it is quite impossible to convey in words, or even in colored moving pictures, the appearance of the eruption. The sound effects should have been recorded, for it is a noisy monster, with many types of roar. When first we saw it, it was in a quiet mood, if one may use that term, sending several bursts of rock and ash each minute up to a height of several thousand feet, while above billowed and towered the omnipresent dust column. The nearest comparable sound was that of a heavy surf on the seashore. Each succeeding rock explosion, however, was followed by a crackling noise like that of a sporadic rifle fire, as the ejected blocks fell back upon the slopes of the cone, or back into the crater, to rise again until they added their bulk to the steadily rising peak.

Meanwhile, the dust cloud, generally spoken of as smoke, rose steadily upwards, welling outwards and rolling in and up as the propelling force of the explosion succumbed to the pull of gravity, and the hot rising gases took over the task of lifting and spreading the finer material. The sunlight shining on the cloud showed it to be gray or brownish, quite in contrast to the white clouds of water vapor which it attracted or almost seemed to form. These vapor clouds remained separate from the dust for many minutes, high up in the air, working in and out among the dust column's puffs.

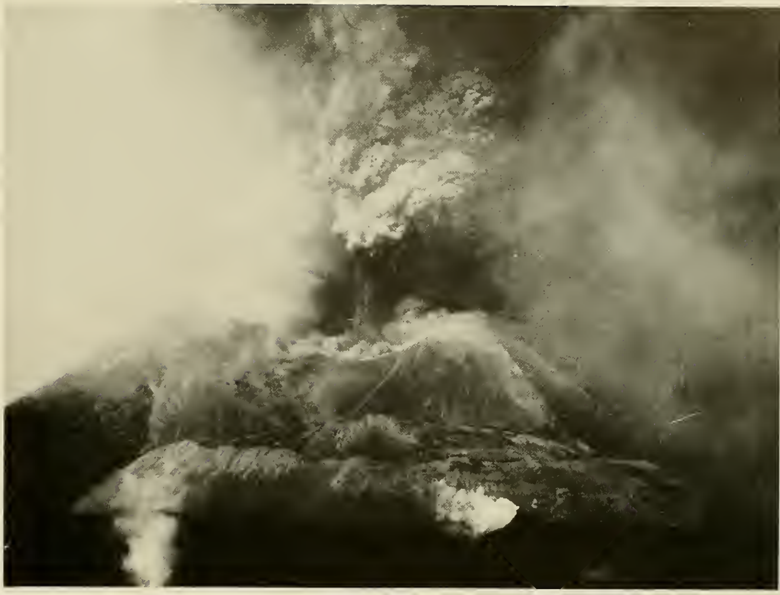
As each volcanic bomb fell, the dust rising from the slopes gave evidence of the strong convection currents that were at work over this center, as did the winds blowing upward across the desolate, ash-covered lava flow and the billowing dust above the cone itself. Ancient artists often pictured lightning flashes in the clouds above the volcano, and one wondered if they let their fancies carry them away and added other wonders of nature to the already awe-inspiring sight. Experience showed that they were right; lightning does form in the dust column, probably from static electricity, quite unrelated to any storm conditions. And so we add another sound to the many already noted—a short sharp crack of thunder, over almost as soon as heard. The flashes are short and all the sound reaches you at once, unlike the attenuated flashes of a summer thunder storm, with their rolling thunder claps.

It is impossible to estimate the total cubic volume of the material which has been expelled by Parícutin since February 20th, but an indication of its tremendous quantity can be gained by a measurement of the ash fall near the cone itself and on the surrounding land for a radius of many miles. Within a half mile of the cone, one walks at the level of the ridge pole of the primitive shingle houses built by the Tarascan natives of the region. A depth of about nine feet of ash has been deposited in this once pleasant typically temperate forest of pine and oak. Farther away, the ash fall is less, and at five miles may be but a foot or so. The prevailing wind, blowing the ash to the southeast in May and June, undoubtedly causes irregularities in the deposit but all the neighborhood has received at one time or another its dose of grit.

As one approaches the volcano the most impressive effect is perhaps psychological; one feels a growing depression as the desolation increases. Fields are deserted, the wild life is gone, the pine trees have all turned yellow and their needles are falling. No one lives in the houses. Any cattle one sees are starving, hopelessly wandering in search of an uncovered blade of grass, eventually dying perhaps, from the poisoning of the vast quantities of ash taken in with their scanty pine needle fodder. The sky is perpetually overcast as though a storm were due to strike at any moment; distant rumbles sound like thunder. It is no wonder that the visitor is truly conscious of a feeling of relief that he can get away when he likes. He is thankful he is not one of those doomed to stay, hopeless and helpless in such a place and wondering what he will do for food, with the planting and rainy season hard upon him.

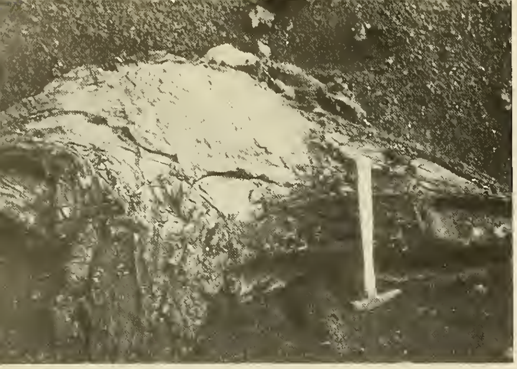
Near the volcano, to leeward and actually under the falling cinders, conditions are even worse. Fine dust rises from the impact of each particle. A steady rain of coarse and fine material makes seeing difficult and breathing worse. Here alone did we find it necessary to tie handkerchiefs over our mouths and noses. Surprisingly enough it was literally cold under this ash shower and a handful of the particles from the sombrero caught in the hand, as one tilted his head, were chilled Apparently they had risen so high that they had lost all of their earlier heat and become chilled in the upper atmosphere before descending to the ground. Anything much larger than a quarter of an inch stung as it struck you, and when, groping almost blindly in the dust cloud, we came too close to the cone, we were terrified by the sudden fall of bombs, with a whirr and a thud, before us and behind us. It didn't take us long to move out of the range of Nature's artillery fire. The stinging impact of the half- or one-inch particles was enough to explain the plight of a lone blue jay, fluttering along with a broken wing, and the otherwise total lack of life. What wasn't buried under nine feet of cinders was no doubt driven away or even killed by the falling masses.

More spectacular and potentially dangerous were the so-called volcanic bombs which are thrown as much as a half a mile by the violent explosions within the crater. In the early days most of these seem to have been liquid, and, whirling over and over in the air, they solidified in elongated club-like or rounded masses, generally to shatter when they struck the ground. Later bombs, characteristic of the dusty phases of the eruption, were not liquid but solid, even though they came out red hot. Whirling over and over in the air has no effect upon their shape, and when they land they look like simple, mechanically rounded masses of porous basalt. With all this solid material milling about in the crater, one might well surmise that a partial source of the dust cloud was from just such mechanical erosion of the solid rock masses, waiting their turn to be

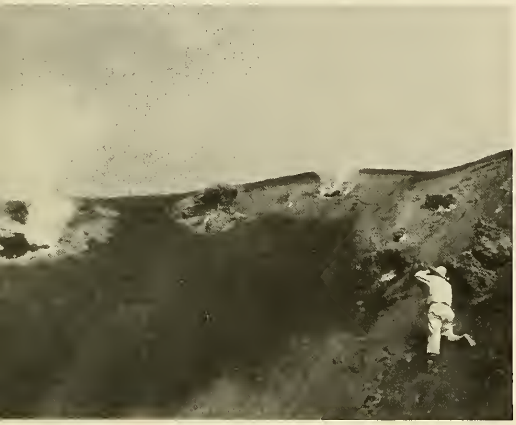


▲ PARICUTIN'S CONE is composed of loose boulders ejected by the volcano and piled one upon the other at the angle of rest. Growth to a height of 1000 feet in four months shows it to be a vigorous baby. The very nature of the cone precludes a strong structure, so rising magma merely pushes out the side in its endeavor to escape in each new lava flow, breaking the smooth contour of the crater's mouth

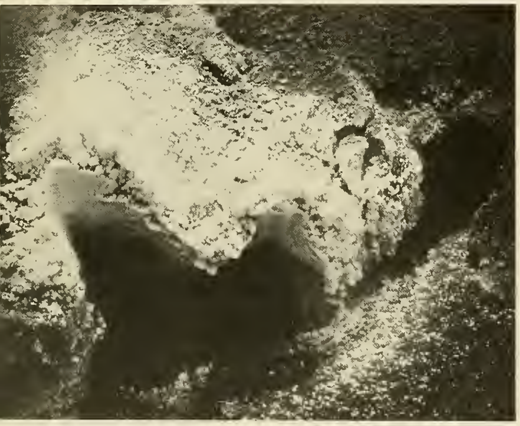
▼ TOWARD DUSK the red glow of the incandescent masses thrown thousands of feet into the air becomes more apparent against the darkening sky. There is, of course, no flame in the usual sense of the word, for there is nothing to burn. Incandescent rocks give the fiery effect, and binoculars show that the luminous cloud is made up of countless tiny glowing particles, like a moving, orange, milky way



◄ THOUGH most of the bombs are solid when they leave the crater, occasional resurgences of fresher magma sometimes cause the eruption of still liquid masses, which shape themselves in flight and spread out when they strike the bottom as shown here



◄ THE LAVA FLOWS, contrary to the popular conception, came out as solid masses. The still plastic interior thrust the outer, already solidified portions forward, breaking them into ever smaller glowing boulders and finally covering them up as fresh material tumbled down. When chilling finally stops all movement, hot vents give off gases which tell the secret of the rocky wall, long after it has become safe to climb upon the flow



◄ CRYSTALS of sal ammoniac, ammonium chloride, coat the fumarole gas vents, forming from the gases as they cool on mixture with the air. Orange and yellow iron chloride sublimates, forming at lower temperatures, line other orifices

◄ DR. W. F. FOSHAG of the United States National Museum selects specimens for analysis and for the collection of some of the few mineralogically distinct products of the volcano. The sal ammoniac crystals equal the best that have ever been found

1

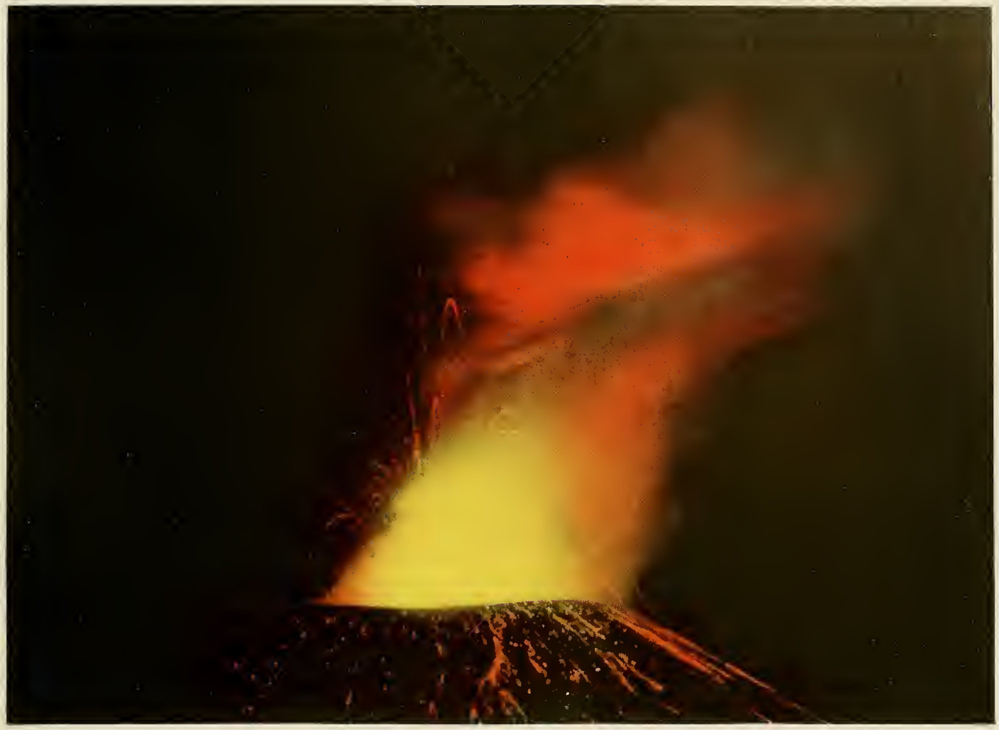
AT NIGHT the cone is outlined by the incandescent bombs that roll down its flanks, breaking up as they tumble along. Closer acquaintance with these will dissuade any daring souls who might have thought of trying to scale the peak with the volcano still active

2

NOT ALL of Parícutin's flows have been solid. The latest was thin and liquid and traveled far beyond the older flow. Before it broke loose it formed a vast bed of coals surrounded by the weak crater-like walls of the earlier flow and its ash covering

3

A FEW MINUTES LATER the confining ridge collapsed and a tremendous flow poured forth, floating many solid blocks of cooled material on its surface and advancing rapidly over the old flow. It reached the abandoned village of Parícutin in a few days, surprising many observers who had thought the village safe when the earlier flow halted short of the nearest house by some thousands of yards



1 Incandescent bombs outline their paths like tracer bullets

2 This fiery bed was dammed by a weak wall—

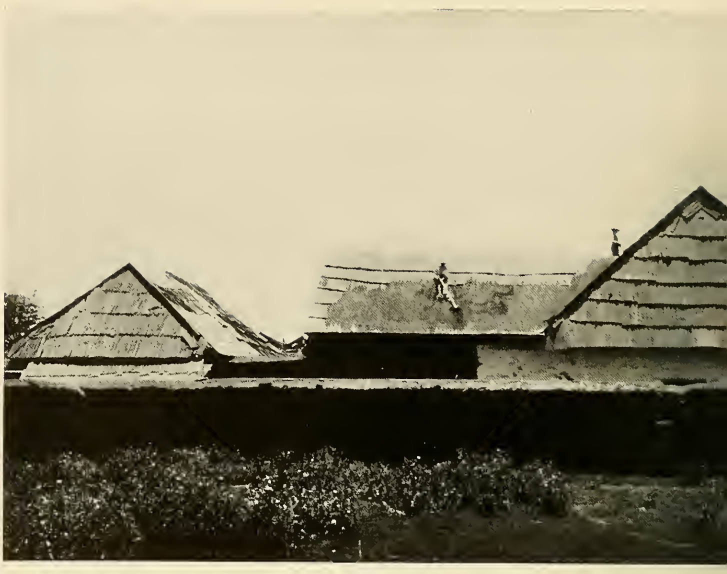
3 The wall broke and the flow poured forth

finally thrown from the crater's mouth, never more to return. During most of the time, solid material alone is ejected, binocular examination of the "fire" seen from a distance resolves it into a red, rising milky way of uncountable particles of all sizes, sometimes here and there obscured by dense black clouds like black nebulae in the sky. Up, up, up the particles go, eventually cooling so that they go out, while the still incandescent larger ones fan outwards and commence their downward arc, taking 14 or 15 seconds to reach the slopes of the cone or the flow below. The big blocks fall nearer the top, often shattering into many fiery fragments, and all roll downwards in sparkling trails.

By day the redness of the blocks is far less apparent, but whenever the cone is approached the number of fallen bombs has increased, each with its small crater around it, for all the world like a moon crater, with a shattered bomb at the center. The stones may be but six inches across, but more are in the one-foot size, and some may be two or three feet. Though they came out hot, few show any shaping in the air. Some apparently had still liquid portions, for cracks along their surfaces are marked by porous, pumice-like combs several inches high. They look as if the force of the impact had driven out still liquid matter from the cracks, only to freeze to glass before it could change its shape.

When later the volcano seemed to have been rejuvenated, the bombs again became liquid, and tremendous flattened masses could be seen which had clearly solidified in that shape, after they had fallen. At this same time there was a renewal, in abundance, of the basalt crusted, rounded, half assimilated granite blocks which were first noted in the early days of the eruption. The implication that a new uprush of magma from the subterranean source had brought along more fragments of the old earth's crust seems inescapable.

The new phase of activity which commenced on June 10th was marked by one other unique feature, the first flow of liquid lava from the cone. The early flow, as can be seen from the pictures, was not the type which is commonly pictured by persons familiar with such volcanoes as those of Hawaii. There, liquid lava actually flows out, often solidifying with the ropy surface of the once molten material. Such flows are the exception in Michoacán and our Southwest, more often the material that shows on the surface is so cooled that it is already solid but nonetheless is steadily thrust forward by the pressure of the still liquid magma far inside. Hence, progress is made by the thrusting of solid rocks, which steadily crumble away, out over already solidified rocks. These are covered in turn by more red hot, perhaps even plastic but still solid material. Such a flow took place at about 11 o'clock on the morning of June 10th, right at the base of a landslide which had formed the night before, breaking away some of the cone.



▲ NATIVES of the nearest town, San Juan de Parangaricutiro, learned caution from the collapse of a few ash-covered roofs weighted down by rain. Now they clear off the accumulations before they reach dangerous thicknesses. The typical Tarascan shingles may shed most of the rainwater, but they were never built to support such muddy loads as ash and rain together

Liquid bombs and violent, earth-shaking explosions characterized the activity of late afternoon on June 9th and that night. At this time the dust was nearly absent, and the large masses that were thrown out spread more widely above the cone and moulded themselves in the air. Since they were more brilliant than the hot rocks of the dust phases, they photographed far better. This activity continued during the night, with ear shattering explosions, strong earthquakes, and shapeless bombs, until early in the morning, when it suddenly ceased, and it gave us a few uneasy moments. The volcano was obscured at that time by a cloud of dust, but in the morning when the mists cleared we saw at once that a landslide had occurred in the night and that the front of the crater had slumped down. This break became deeper as we watched, and at its base, rocks kept tumbling downward, with clouds of gray dust rising rapidly up the slope of the cone.

While this was being watched, the gray dust started to turn red at various areas; because, as became apparent afterwards, the rocks were getting hot and the iron in the rocks was oxidizing to a red oxide form. Soon, a big boulder cracked open and showed red within the crevice, and within a few minutes, many rocks were crumbling down, exposing glowing surfaces on each new break. This flow advanced down a gulley in the top of the earlier one and progressed about 150 feet in four hours, merely by piling one hot boulder after another forward over its predecessor. Here was a new sound effect, a steady tinkle from the sliding, falling rocks, accompanied by a loud crackling like that of a hot fire, as the cooling surfaces cracked open and the rocks broke up into smaller masses. The surface of the old flow, now coated with ash, was marked by long fault scarps six or eight inches high, showing that the new flow was pushing the old material along beneath it, and that that was still sufficiently liquid to yield with a relatively small stress. The cracks ran more or less parallel to the direction in which the flow was progressing.

Very little gas seemed to accompany this flow; only a little steam formed, probably from rainwater which had fallen on the cold ash during the night. At the edge of the first flow, however, there were many fumaroles, or gas vents, some giving off steam, around which yellow and orange iron chlorides were forming, while others with a bluer vapor, were bordered with white crystals of sal ammoniac, ammonium chloride. Specimens of that mineral, better even than those of Vesuvius, were to be found along the margins of the old flow, where it was forming at temperatures around 180° F. The iron chlorides formed at even lower temperatures, perhaps around 150° F. and definitely further out from the orifices than the sal ammoniac. One crevice in the old flow still showed red glowing rocks, after three months, and a pyrometer gave a temperature for that spot of 1600° F. One would guess that it will be many years before that lava mass has cooled off.

Some of the Tarascans have resolved to make the best of the misfortunes and have moved to the site of the "Observatory" to sell tortillas and frijoles. The nightly influx of hardy tourists soon require refreshments of some sort

The most spectacular event of the recent history of Parícutin was the birth of a new lava flow, the first liquid flow, which took place around 7:30 in the evening of June 10th. It has been variously reported as a new cone and as a new eruption. It appears to have been neither, though the source of the lava is something of a mystery. A lot of steam or gas was visible in the evening off to the west from the nose of the morning's flow, whose advance had about halted by that time. As it became darker, a glow was evident on the steam, and it at once seemed probable that it marked another flow which had been overlooked by the day's interest in the nearer flow.

The writer resolved that he would have to have a look at it; but after making a wide detour to approach the glowing steam column, he found it rising from the top of a small pressure ridge, built up of loose faulted ash, rising perhaps 50 feet above the general level. Thinking that the lava front must be on the other side, another detour was made and the identical condition discovered. There was, then, no alternative but to struggle up the slope, which felt cool to the touch and safe to climb.

On reaching the top, a bed of hot coals, looking for all the world like a tremendous furnace bed 100 feet across, was seen, about ten feet below the ridge. As the tripod was being set up for some pictures, the ridge was felt to move a bit, so little time was wasted after the pictures were obtained. Within a few minutes, the hot bed thrust upwards and forward, toppling the ridge over, and the first liquid flow came out, with solid rocks of various sizes riding along on its surface. The lava advanced very rapidly, for it was coming down a moderate slope and covered several hundred feet within an hour. At the point where the ridge had been, there was a tremendous outlet of gas, which roared off in a spiraling clockwise tornado perhaps 20 feet in diameter and sounded as if it had irresistible force. Dark as it was, with only the light of the hot lava, one could still clearly see the tornado of hot gas. The lava flow was the thinnest to date, not over eight or ten feet thick, but made a wall of lava over one quarter of a mile long, advancing over the earlier flow until it reached the still exposed tree-covered slope on the other side of the little valley, where it was to be seen by morning. Trees were surrounded and set to smoking, and the flow then followed down the valley, following the course of the earlier flow.

From subsequent reports, this flow seems to have continued until it reached the now abandoned village of Parícutin. In any case, we should discount the stories of a new volcano and a new vent, for it seems to be just another flow. However, the source of this lava was a little indefinite, for after leaving the foot of the flow, the first ridge seen was found still to be intact, and was climbed in turn. Here the flow was seen spreading out below, and seemed to be coming almost from beneath the ridge. Gas still continued to whistle out, and rocks to crumble away, but where all that lava came from no one can say.

Here was noted an interesting phenomenon at its best—trickles of red hot sand following down as each block of red rock collapsed, and looking exactly like a liquid to the careless observer. This is undoubtedly the explanation of the mistaken impression of many that they have seen molten lava, when there really was none.

Fortunately, the region in which the volcano appeared is not thickly populated. It is hilly forested land, the pines being principally used as a source of turpentine, with clearings in suitable places in which primitive agriculture is carried on. Consequently the damage wrought is relatively slight, and comparatively few people are affected. Ash falls of several feet within a radius of about five miles will make the fields unsuitable for agriculture for some years. With the eruption still continuing, it is, of course, impossible to say just how much the final deposit will be, and it would not be worth while attempting to reclaim by deep plowing the fields along the thinner fringe until all activity has died down.

The only injury that has resulted has been caused by carelessness and thoughtlessness, and even the hut of the Instituto de Geologia suffered in this way. Heavy ash falls near the cone piled up upon the sloping shingled roofs in Parícutin, San Juan and at the observatory, but their danger was not appreciated until several collapsed as the result of the added weight of rain. Some people have been injured in this way; two were American tourists who were spending the evening watching the eruption. Wiser now, the natives soon clear off the ash accumulations before they reach a dangerous thickness. In near-by Uruapan some tile roofs were taken up, piece by piece, and replaced after the ash had been removed.

It was difficult to leave Parícutin when so much was going on and when the volcano had really outdone itself to give a fine show for the cameras. What the subsequent history of the volcano will be no one can say, for we have little data on which to base an opinion. According to tradition, Jorullo continued in activity for fifteen years, until 1775, with its greatest activity after about six years. Perhaps Parícutin will do as well. However, Jorullo reached a height of 1000 feet only after all of this activity, while Parícutin was 1000 feet high after a brief four months. Jorullo developed several subsidiary or parasitic cones along the fissure which gave rise to the main volcano. Parícutin has yet to break out in this way, unless subsequent activity and observation confirm the reports of a new vent. The writer's observations on the night of June 10th make this seem unlikely. Perhaps Parícutin will continue for many years, perhaps it will die down shortly. When it is finished it will never erupt again, for the cinder cones which dot the countryside are clearly the products of a single continuous eruption. So while it is active it should be studied in the greatest detail, and it is well worth a visit, despite the many inconveniences, for any who can get there.

VITAL FIBERS

Continued from page 121

That America can adjust its agriculture to sudden needs is being proved in Kentucky, where a pre-Revolutionary hemp industry is now expanding its acreage and proving that it can supply fibers equal to any from the Philippines. The acreage in the United States has increased 25-fold in two years, and 71 new mills to process the hemp are under construction.

Emergency production of hemp in America was decided upon for several reasons. Hemp produces fiber from a single year's growth, and it grows well in the Midwest. Its yield per acre, furthermore, is almost double that of flax, the only other fiber plant that grows well in this country.

Hemp fiber is more like flax than any other commercial fiber. Its cultivation requires considerable labor, but presents no great difficulties as long as fertile soil and an annual rainfall of 30 to 35 inches are available. When the plant is grown for seed, it is planted in rows like corn, and the harvested shocks are dumped on squares of canvas and beaten with flails to knock out the seeds—a process as old as farming itself. When grown for fiber, hemp is planted like wheat or oats, and with similar machinery. After a growing season of only 120 days, the stalks are harvested by a special harvesting machine which spreads them on the ground in an even mat, where they are left to rot for 3 to 8 weeks. Another machine gathers them and binds them into bundles. The bundles are allowed to dry and are then taken to the mills to be processed during the winter.

Hemp is used extensively in twines and rope, certain types of marine cordage, parachute ribbing for the air forces, textile fabrics, thread for shoes and harness, fish-nets, and carpet warps; and its tow is used in the manufacture of oakum.

Chile and Argentina are also expanding their hemp industry.

The fiber which is meeting more vital war needs than any other crop is cotton *(Gossypium hirsultum)*. It is second only to steel among the country's major weapons of war. Cotton fiber has long played such an important part in the everyday life of the average American that it has come to be taken more or less for granted. Its dual role as a strategic military item and a vital home-front food, feed, and chemical crop is not generally appreciated. As an example of the importance of cotton, consider that 1400 pounds of cotton produce 500 pounds of fiber for military, lend-lease, priority, and essential civilian needs, 140 pounds of high-grade vegetable oil for food, 400 pounds of protein meal and cake for livestock feed, 240 pounds of hulls for livestock roughage and chemical use, and 81 pounds of linters for smokeless powder, plastics, and numerous other essential products.

The purest known source of alpha-cellulose—chemical base of many war products—is cotton linters, a mixture of long fibers and fuzz escaping removal in ginning. Cotton linters have been classified as a "strategic" material of war by the Army since 1940, and they are rated as "most critical" by the War Production Board today. Most important of all the wartime uses is in the manufacture of smokeless powder. One bale of linters will provide smokeless powder for 100,000 rounds of rifle ammunition. Linters are also essential in the production of synthetic yarns, X-ray and photographic film, and the glasslike windows of bombers.

More than 70 per cent of all the cotton fabrics are now produced for priority needs. Approximately 11,000 cotton items appear on the procurement lists of the Quartermaster Corps, ranging from shorts to ski suits and from mosquito netting to the heaviest tarpaulins. It is estimated that each soldier in our army requires about 120 yards of cotton cloth per year.

Varieties of Egyptian cotton *(G. barbadense)* with extra long staple, valuable in the manufacture of parachutes and other aviation materials, are grown in Egypt and also in our Southwest. Another variety known as Sea Island Cotton, with the longest, finest, and most valuable of the world's cotton fibers, is grown in Puerto Rico.

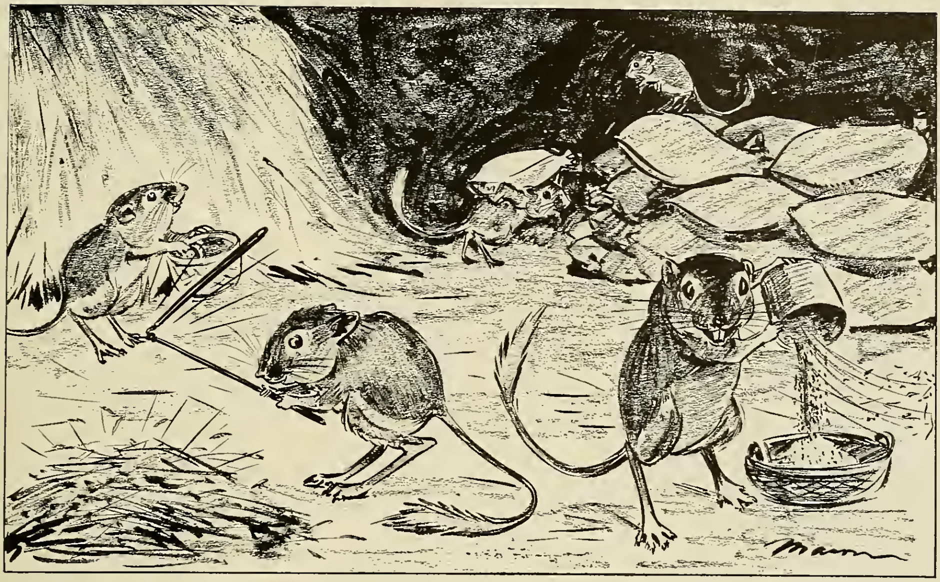
According to *Science News Letter* cotton rope, treated with a new preservative, is now being used on ships, although it cannot serve the more important purposes for which Manila rope is needed. The preservative gives the cotton rope firmness, resistance to wear, and protection against marine organisms.

Rayon is made either from wood pulp or from cotton linters and is pure cellulose. Other chemically manufactured fibers, under a variety of trade names, depend upon plant products. Fibers as yet unnamed and unmarketed have been made by chemists from peanuts and from corn. These are proteins and have properties resembling wool.

War is very hard on clothes. It is stated that winter uniforms in active service wear out five times as fast as did civilian suits. With wool becoming scarcer, a substitute has now been found in soybeans *(Soja max)*.

Continued on page 148

HARVEST HOME



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

The seasons are not uniformly favorable. At times there is an abundance of food for the plant-eaters, and then periods come when little or no vegetation of edible sort can be found. The little rodents that feed almost entirely on seeds are especially affected by the seasonal changes, and those that live in the dry regions of the world are subject to the most extreme variation. In the deserts and dry plains of southwestern United States a rainy winter and early spring cause the country to "blossom like the rose." I saw the results of such a season in the southern San Joaquin Valley, California, and shortly afterwards in the Mohave Desert. Standing on the mountainside it seemed as if a vast, brilliantly colored Oriental rug were spread out over the country. Solid masses of bright violet blue lupines, clumps of orange poppies, and the red, yellow, purple, and white of other flowers made an unbelievable spectacle.

As the summer follows the spring, the flowers fall off and the seed pods ripen; and there is a far larger supply of seed than the seed-eaters can use up. Later the grasses ripen, also some summer flowers, which means still more seeds. And the autumn has its crop; many of the thistle family bear their seeds late in the year. But during the winter and early spring there is little or nothing to be found growing that the seed-eaters care to eat. Many years there is a scarcity of moisture; the spring flowers and their seeds are few, while many of the later flowers fail completely. The desert rodents must do something about this problem, and they act as if they were as wise as we are. They lay in a store of food.

Kangaroo rats are almost exclusively dependent on seeds. During the periods when seed-crops are ripening they are as busy as they can be. As soon as the light of day completely disappears, a kangaroo rat comes out of his underground home, and hops down a well-worn path to a patch of ripe grass. Standing on his long hind legs, partly braced by the long, white-striped tail, he reaches up with his small front feet and pulls down a grass-head. A snip of the sharp front teeth and the head is off; if it is long, it is cut up into inch-long pieces and each section is put into a cheek pocket by a quick movement of the paw.

The pockets are fur-lined. They open on either side of the muzzle, outside of the mouth, and reach back to the shoulders. It takes only a minute or two to fill them. They hold about a heaping tablespoonful of grass heads apiece.

Then back to the den goes the harvester, and down into its winding labyrinth. Each kangaroo rat knows the twists and turns of its home burrow, and this one goes straight to one of the storerooms, a rounded chamber at the end of a passage. Inside this room the pouches are emptied by quick forward pressures of the paws. The grass-heads are packed snugly into the pile already there, and in less than a minute the kangaroo rat is back to gather more.

The storing habit is deeply ingrained in the kangaroo rats. If one is caught and then given the choice between freedom and gathering up scattered grain, if not frightened by sudden movements or noise, it will usually gather up both pockets full before trying to escape from the strange surroundings. Once it has "filled up," it will try to escape.

The amount of food that may be stored away by a five-ounce kangaroo rat is surprising.* A bushel basket may be filled with the piles of grass-heads stored in an average den, and more than two bushels have been found. Such stores are the results of a thorough harvest of about 100 square yards, and may involve more than half a million separate cuttings. That is pretty industrious harvesting!

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*See, Vorhies, C. T. and Taylor, W. P. 1922. U. S. Dept. Agric., Bull. No. 1091.

YOUR NEW BOOKS

ROY CHAPMAN ANDREWS' AUTOBIOGRAPHY ● THE AMERICAN LAND
MINERALS IN WORLD AFFAIRS ● THE SHINING TRAIL

UNDER A LUCKY STAR

A Lifetime of Adventure

- - - - by Roy Chapman Andrews

The Viking Press, $3.00

THE title of this autobiography of Roy Andrews indicates a modest,—too modest,—point of view on the part of the author, for the life of this explorer has been infinitely more than a series of lucky episodes. How appropriate the subtitle is! Certainly few explorers have had a life so full of real adventure.

If any one starts to read this book, it is a safe prophecy that he will read it through to the end. The only trouble with it is that there is not enough of it. His stories are too short, and his friends will know that there are other adventures that might well have been included. In one place he disposes of an experience with eight Manchurian bandits in one sentence! And we should like to have known more about some of the persons he mentions so briefly.

Roy Chapman Andrews will rank with the greatest explorers of the world,—with Peary, Nansen, Scott, Shackleton, Amundsen, and Byrd. He will always stand out as a great organizer, a leader of men. It was a most significant fact that after he returned from one of his expeditions, every member was ready and anxious to go back with him on the next. It was evident that he did not quarrel or fall out with his men.

His success was largely due to his unbounded enthusiasm, for nothing great is ever achieved without this heaven-sent gift. And this enthusiasm was contagious, and inspired his men to share his determination to succeed.

This book is Roy Chapman Andrews, written in the style of his lectures, and if only as many persons read it as applied for places on his Asiatic expeditions, it will have a wide public.

CLYDE FISHER.

HOW TO RAISE RABBITS FOR FOOD AND FUR

- - - - - - by Frank G. Ashbrook

Orange Judd Publishing Co., $2.00

THE title indicates quite accurately the general nature of this book. It is a simply written, practical guide to the raising of rabbits as an item of diet and as a source of fur. The list of the chapter titles shows that all important aspects of the subject have received the author's attention: Rabbit Meat for the Family; Advice to Beginners; Location of the Rabbitry; Choosing a Breed; Breeding; Feeding; Prevention and Treatment of Disease; General Management; Judging Rabbits; Preparing Rabbits for Market; Tanning Rabbit Skins; Marketing Meat and Fur; and How to Cook Domestic Rabbit Meat.

There is very little that the reviewer can say about this volume except to note that the coverage of the main aspects of the subject is exhaustive and the general treatment authoritative. A few of the author's attempts to explain in nontechnical language the scientific basis for some of the advice given might be regarded as too foreshortened to serve any useful purpose. For example, the discussion of the basic factors of heredity is limited to two and one-half pages, and, in the opinion of the reviewer, adds nothing to the value of the book. However, the detail in which the practical problems are discussed more than compensates for a few minor inadequacies in the coverage of secondary problems.

In times when a meat shortage is so pressing in many parts of the country this useful guide to the cultivation of an inexpensive source of fresh meat is to be regarded as a useful contribution to current literature.

F. A. B.

THE AMERICAN LAND, ITS HISTORY AND ITS USES

- - - - by William R. Van Dersal

The Oxford University Press, $3.75

THIS is a book that the reviewer can heartily recommend to readers of many different interests. A more timely subject could hardly have been selected, since the war has made the American public aware that the resources of our land are far from being unlimited and that efficient methods of land use are needed for the continued supply of our needs. Mr. Van Dersal is one who can be trusted to deal well with this subject.

He has been remarkably successful in condensing into a small volume an immense amount of information about the history and development of American agriculture in its different branches, beginning with the clearing of the primeval forests and describing the great changes that the occupation of the country has brought about. As might be expected, he is strongly conservation-minded, and has much to say in condemnation of the waste of resources that has occurred and which is in many cases far from being ended. What he tells about over-grazing on the western ranges, the squandering of our timber supply, erosion and methods of preventing it may not be new, but they are matters that need more attention and more action.

The chief achievement of the author is his remarkable success in describing and picturing in a clear, concise, and interesting manner the present agricultural uses of our land. He gives an especially good description of the origin, history, and methods of cultivation of the various grain, fruit, and vegetable crops.

The numerous attractive and well-chosen illustrations deserve special mention. Without impairing the readable quality of its pages, statements on the acreage and production of all important crops are included to an extent that makes the work a useful book of reference as well as one that many people will enjoy reading through if they once open it.

WILLIARD G. VAN NAME.

THE IRISH STONE AGE

- - - - by Hallam L. Movius, Jr.

Cambridge University Press, $7.50

THE core of this book is a brief, illustrated account of that part of the 1932-36 Harvard Irish Survey which dealt with the island's Stone Age archaeology. Specifically it describes the results of excavations at a cave in the south near Cork, a northeastern inland habitation on the shore of Lough Neagh, and four marine shore sites facing the North Channel opposite Scotland. Twenty thousand flint specimens, mostly of Mesolithic culture, were found.

Unfortunately, or perhaps fortunately, the four rich marine shore sites were secondary culture deposits piled up in mixed condition chiefly by wave action incidental to a temporary coastal submergence in early post-Glacial times. The author gives us an admirable, detailed study of the interplay of human and natural activities, which partly destroyed cultural remains. As a result, we now, for the first time, know something definite about when man first arrived in Ireland, as well as how and under what conditions he lived from the earlier times onward.

Briefly, the author rules out the alleged indications of the presence of Paleolithic culture in Ireland by showing that the first immigrants brought a culture of Azilian affinities at the end of the last glacial retreat (about 7000 B. C.), when Ireland was all but connected with Scotland. Descendants of these firstcomers are still regarded as recognizable in certain parts of the island. For a long period the early people were out of contact with their Scottish and British neighbors and thus naturally developed a somewhat unique flint industry.

Doctor Movius, with V. G. Childe and J. G. D. Clark, stresses environment rather than typology. However, he had in this case little choice, his culture material being qualitatively rather poor. The book contains several appendices, a valuable bibliography, and a good index. The only critical comment the reviewer can think of is that the subject matter does not quite correspond to the title.

N. C. Nelson.

BEEKEEPING FOR PROFIT AND PLEASURE

- - - - - - - - by Addison Webb

The Macmillan Co., $2.00

THIS is a guide to the elements of beekeeping. As such it is good.

The style is definitely "popular"—in places rather overpopularized. For example, it seems unnecessary and even undesirable to violate our knowledge of insect psychology by saying that at the approach of winter "the bees wander gloomily over the comb and look sourly at the remaining unhatched eggs and baby brood. These, they know, increase the problem of wintering. The more hard-hearted ones take an egg out of the cells, and examine it, bitterly. Others gather about her, watching, mutely. She starts off with it, a few steps; the circle gives way, sorrowfully; an unborn bee is about to be sacrificed for the safety of the colony." As an example of a readable book about bees that stays within the technicalities without being technical see Teale's *The Golden Throng* (Dodd, Mead & Co.), which does not, however, deal with the mechanics of beekeeping.

On the other hand, Webb's book is safe on the practical side, particularly for the beekeeper who does not wish to have more than one or two hives—beekeeping chiefly for pleasure. If the reader is thinking of going into beekeeping for profit on a really commercial scale he would do well to have a more complete book such as *Beekeeping* by E. F. Phillips (The Macmillan Co.).

Why not have all three?

Frank E. Lutz.

ISLANDS OF THE PACIFIC

- - - - - - by Hawthorne Daniel

G. P. Putnam's Sons, $2.50

THERE has long existed a need for a handy reference book to the multifarious islands of the Pacific. That need has, of course, become acute with public interest focused on islands hitherto unheard of in most American homes. In *Islands of the Pacific* Mr. Hawthorne Daniel provides such a compendium for ready use. He lists the major and minor islands of the Pacific, reducing the better known large ones to the same succinct compass as he uses for the lesser known small ones. A brief description of location, topography, population, products, and similar items of information are given for each island. Since much of the data that Mr. Daniel has assembled is scattered and often difficult to find, his book serves a very useful function.

H. L. S.

COMPENDIUM AND DESCRIPTION OF THE WEST INDIES

- by Antonio Vásquez De Espinosa

Translated by Charles Upson Clark

Smithsonian Institution, $2.50

HERE is a great work, as diverting as Diaz and Thomas Gage. In spite of its sober jacket, its 800 pages of chronicles, travels, and every-day observations of the natives and the early Spanish rule in Mexico, Central America, and the Inca lands deserve growing attention.

Espinosa died in 1630. As a Carmelite missionary he had spent some years in America, returning to Spain in 1622. It was known that he had compiled a work on his travels, but for three centuries it was considered lost. Mr. Clark's accidental discovery of the MS. is excitingly told.

Espinosa visited the districts when many of the temples and other public buildings still stood. Some interiors apparently remained almost intact. Since the author was a thorough friar, we get a complete picture of the natives' transition from pre-Columbia culture to a condition dominated by the Church and State. It is an unpleasant picture but faithfully told. The author goes into the lives of the people, their hardships, customs, superstitions (he displays a few of his own!), illnesses, cures, industries, agriculture, etc. There is hardly a phase he does not touch upon. He expresses great admiration for their attainments; and he devotes many pages to their pre-Columbia history.

Of interest to fossil hunters is his frequent mention of the bones of "giant men," and perhaps his most fascinating pages are those "Of the Cuzco Fortress and Its Incredibly Huge Stone Blocks" (Ch. LXXVIII). It has baffled researchers how men of a stone-age culture could hew and haul the mighty boulders that make up the Sacsahuamán fortification. True or not, his story of its erection and of how 20,000 men tugged at one stone—which broke loose and rolled back onto 3,000 of them—is a saga in itself.

L. J. Salter.

THE SHINING TRAIL

- - - - - - - - - - by Iola Fuller

Duell, Sloan & Pearce, $3.00

THIS historical novel is packed as full of dependable Indian life and struggle as was the recent excellent biography of Crazy Horse, by Marie Sandoz. In fact, Iola Fuller's book is essentially biography, as she states in an introductory note: "The incidents in this novel leading up to and following through the Black Hawk War are based on historical fact, with no liberties taken except to add fictional characters and eliminate a few real ones who played minor roles."

In 1939 Miss Fuller won the Avery Hopwood Award for her first historical novel, *The Loon Feather*—the story of an Indian girl, the daughter of Tecumseh, during the fur-trading days on Mackinac Island.

The Shining Trail is even a finer piece of writing, and that is indeed high praise. Written with dignity and beauty, the

Continued on page 146

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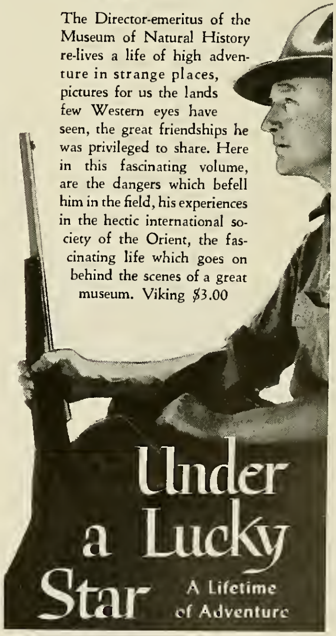

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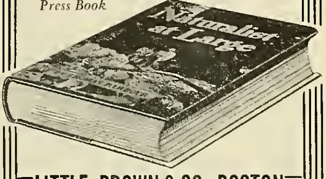

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Continued on page 145

author speaks through the mind and heart of the Indian in a prose that sings. The characters are finely drawn and they live. The injustice and treachery of the land-grabbing, treaty-breaking whites, as abetted by pioneer politicians, is vividly depicted.

Black Hawk, Chief of the Sauk tribe, was one of the great Indians of the last century—great in war and great in peace. He tried every honorable way possible to walk the trail of peace with the white man. Naturally he and his people did not want to give up their beloved village of Saukenuk, situated at the mouth of the Rock River, where it flows into the Mississippi. Here is the tragic story of how they were forced to surrender their ancestral homes and were driven beyond the "Father of Waters," hunted down like wild beasts. Even their women and children were pursued and killed on the way.

In spite of all the hopeless struggle with its inevitable outcome, a charming and moving love story runs through the book. We have had very few authors who have written with so thorough understanding of the Indian way of life.

Te Ata.

How to know THE SPRING FLOWERS

- - - - by Mabel Jaques Cuthbert

Published by H. E. Jaques,
709 N. Main, Mt. Pleasant, Iowa.
Spiral Brochure $1.50; Cloth, $2.50.

THIS is the sixth little volume in Professor Jaques' Pictured-Key Nature Series. In the first five he was the author as well as the publisher. In this book Mabel Jaques Cuthbert has attempted to bring together the more familiar spring-flowering herbaceous plants of the United States and southern Canada, and she has succeeded in including many of the common and best-loved flowers of this large area. The grasses, sedges, and rushes are not included. While no two nature-lovers would agree upon which flowers to include and which to leave out, one cannot help wondering why eight species of Trillium are included and only one true Lily. How could the Wood Lily and the Turk's-cap Lily have been omitted? They bloom about as early as the Canada Lily, which is included. Or, why six species of Buttercups and nine of Violets are treated and no white Water-Lily, which blooms as early as the Yellow Pond-lily, which is included.

Preceding the Pictured-Key to the flowers are brief chapters on plant parts and what they do, suggestions for plant projects, how to make a herbarium, how to use the keys, and a list of good reference books.

Over 300 species of spring-flowering plants are keyed and illustrated. Mention is made throughout the book of related plants that have been omitted. The keys are simple and clear and workable. The line drawings are fine, one of the most valuable features of the book. This is an excellent manual for those who are not ambitious to become master botanists but who would like to become acquainted with the most common, the most beautiful, and the best known spring flowers.

Clyde Fisher.

MINERALS IN WORLD AFFAIRS

- - - - - - by T. S. Lovering

Prentice Hall, $5.35

THE combining of history, economics, and mineralogy in a single volume is a difficult task because an authority in one field is unlikely to be also an authority in another and relatively unrelated science. In a work primarily concerned with the world's mineral resources there is little space to be anything but dogmatic about the events of history leading up to World War I and subsequent developments responsible for the present conflict. Taking issue with the preliminary portion of the book would be a fruitless task. However, the next chapter, dealing with geology gives a fine résumé of the subject for readers unfamiliar with the science, and this is followed by a series of chapters on different mineral resources.

Here we have an excellent summary of economic geology. The major deposits are described, also the uses, technology, and geological relationships of each substance. Several maps show the world distribution of deposits. More materials are included than just the strategic group; coal and petroleum, for instance, iron and steel, molybdenum, vanadium, copper, lead and zinc.

The author apparently intended his book for students or reference, as few of the interesting high lights which make for readability have been included. Illustrations of interesting ore specimens might also have improved the general appearance and attractiveness. The maps are interesting, but could have been made more informative with a different arrangement of symbols.

In spite of these criticisms, however, it is a very valuable book, for it is the only work of which the writer knows in which this information is to be found in such a compact form. It will be useful both as a reference work and for occasional reading.

F. H. Pough.

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Oct. 20—*Bad Snakes and Good Venoms*—Charles M. Bogert
Oct. 27—*Six-Legged Saboteurs*—Dr. C. Howard Curran

This program is now under the sponsorship of Natural History Magazine.

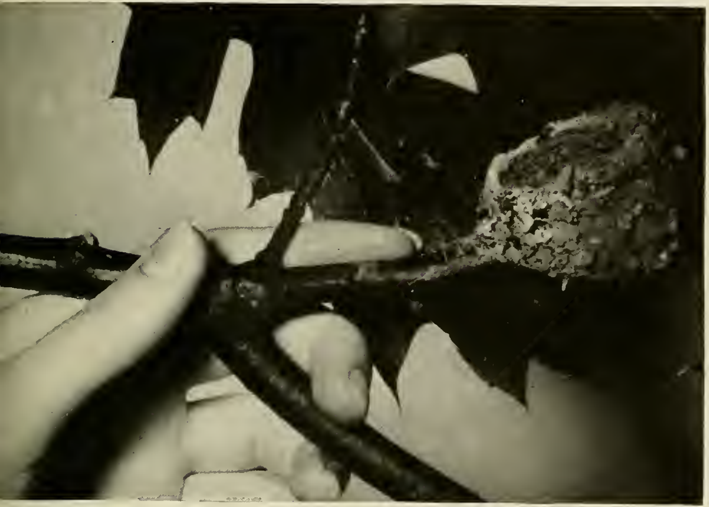
Continued from page 103

SIRS:

This will be my second year to receive your fascinating magazine, and please let me say that I have never before so thoroughly enjoyed a periodical. NATURAL HISTORY is in a class by itself—no other magazine can approximate it.

DOROTHY MACNEIL.
Framingham, Mass.

▼ THE NEST OF A RUBY-THROATED HUMMINGBIRD, the only hummingbird found in the eastern half of the United States. Because of the bird's small size and its rapid wing movements, it is often mistaken for a moth. The tiny nest is a cup of soft, felted material covered with bits of lichen. Submitted by Edwin C. Meyenberg



A.M.N.H. photo

SIRS:

With most other magazines and with all newspapers stuffed full of war stories and information, it was a pleasure to see that the editors of NATURAL HISTORY had, consciously or not, been keeping this type of material out of the magazine. This policy, if there was ever such a policy, seems to have changed with the introduction of "Everyman His Own Robinson Crusoe," in the June issue. It is fine to describe New Guinea, the Solomons, the Aleutians, etc., but I believe that an article such as the above doesn't belong in NATURAL HISTORY and would have better been placed in the "Times" or in "Life."

Let's have some more articles such as "Pastures of the Sea" and "Environment and Locomotion in Mammals."

SEYMOUR D. ADAMS.
Long Beach, L. I., N. Y.

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

How important are Mineral Resources?

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By T. S. LOVERING

Professor of Economic Geology
University of Michigan

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Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

VITAL FIBERS *Continued from page 142*

The soybean is an eastern Asiatic legume long cultivated for the oil, flour, and meal derived from its seeds. Two hundred pounds of soybean wool can be produced on the same amount of land that will yield only five pounds of sheep's wool. Before the war most of the cloth made of soybean wool went into automobiles. At present about 1000 pounds of soybean wool are produced each day, and all this is going to the armed forces.

Few plants have been overlooked in the frenzied search for fibers. The bark of redwood trees *(Sequoia sempervirens)* yields a fiber like jute; even seaweeds yield fibers from which thread can be made.

Lastly, kapok deserves attention, because of its uses in life-saving apparatus and sleeping bags, as insulation, and as a stuffing and filling material. This cotton-like material is taken from the seed-pods of the silk-cotton tree *(Ceiba pentandra)*. Native to the tropics of America, it was introduced to the Far East by early Portuguese navigators and is now cultivated chiefly in Java and Sumatra. The tree attains a height of 100 feet or more and is spectacular because of its far-reaching branches and wide-flung flanges or buttresses, which sometimes extend 30 feet or more up the trunk.

The pods are gathered by hand, usually from wild roadside trees, dried, and then the down and seeds are removed. Kapok cultivation has been undertaken in various parts of Latin America, where it may become a profitable household industry, even though conditions do not give it promise as an important plantation industry.

The homely milkweed *(Asclepias)* and cattail *(Typha)* are being exploited as substitutes for kapok. The floss of these plants is very similar to kapok in spite of their other differences. All have hollow fibers, which explains the flotation power so important in the manufacture of life belts. Milkweed floss is five or six times as buoyant as cork, and a life jacket with a content of a few pounds of the floss will hold up a 150-pound man. It is warmer than wool and six times lighter. Flying suits lined with milkweed floss are warm and lightweight, and if a flier falls into the ocean, the suit will act as a life preserver, whereas a sheepskin-lined suit adds to the danger of drowning.

Milkweed floss was harvested in Michigan last year, and the plans for 1943 call for the development of this new source of fiber. Cordage and fabrics can be made from the bark fiber of the stalks, and oil can be extracted from the seeds. Cattail floss has many of the same properties. Truly can it be said that we are discovering unsuspected needs for the commonplace things of Nature.

[*Next month: Rubber.*]

THE COVER THIS MONTH

October NATURAL HISTORY 1943
Flying Reptiles · Fibers · Whither Man? by Gregory
Birth of a Volcano · The American Buffalo · Shells
FIFTY CENTS

The Kodachrome reproduction by Ruth Bernhard shows the Lion's Paw Shell *(Pecten nodosus)*. This is one of the most striking of the large and colorful family Pectinidae, which includes the scallops. The nine most prominent of the series of radiating ribs are adorned with conspicuous knoblike projections. This shell occurs along the Atlantic Coast from Cape Hatteras to the West Indies and the Gulf of Mexico, in water 50 to 100 feet deep. It is often brought up by the sponge divers on the west coast of Florida.

URGENT

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, Natural History, New York, will be greatly appreciated.

Teaching and Research

Since one of the main functions of education is the diffusion of knowledge and understanding gained by research, one might think that a union between teaching and research would be looked upon as an ideal marriage approved by all. But such, unfortunately, is not the case. A genuine appreciation of the need for a personal and intimate relationship between the search for new knowledge and the teaching of old seems even rarer than it has been before.

Among the general public it is quite common to find the belief that wherever research and education are found together they can only exist in a state of competition with each other. And a conscious or subconscious opposition to the requirements for research in our educational institutions is frequently expressed in the acts, if not in the words, of the representatives of the public interest, since education is something in which the entire public participates, while only a few can engage in research. In sheer self-defense the scientifically inclined respond by intensifying their preoccupation with research and minimizing their educational obligations. And so the suspicion brings about the crime.

By their liaison position between the general public and the world of pure science, and their dependence upon the moral and financial support of both, the public museums are particularly exposed to the ill effects of the failure to understand the relationship between teaching and research.

He who ceases to learn also ceases to be a good teacher of others. This was true even in the days when human knowledge changed very slowly, since its truth is based upon the need for a continued sympathetic understanding of the difficulties of learning, based upon personal experience of the process. It is doubly true today when the body of knowledge itself is so rapidly changing and progressing.

Having to provide for the continual education of the educators has therefore become one of the most serious problems of modern teaching.

In the training of our children, the value of their own independent studies of the literature and other sources of information is universally recognized, without consideration of the immediate practical usefulness of the subjects on which they write their themes.

But, in spite of this approval of the "student research" method for the education of the pupils, there is little public sympathy for the educator's own need to apply to himself the same method of individual research, as the only reliable means of maintaining the vigor of his teaching, and keeping his knowledge abreast of scientific progress.

This lack of sympathy is particularly dangerous when it extends to advanced education in institutions of higher learning, dependent upon public support, because the need of applying the research method in such institutions is particularly great. The quality of elementary teaching may be adequately maintained by a reasonable system of refresher courses, by the writing of popular articles, and in hundreds of other ways. But even before admission to advanced teaching, the educator is supposed to possess a command of the knowledge behind and beyond the advanced textbooks he uses. The only direction in which he can continue his mental progress is therefore on the path of original research into the previously unknown. Without opportunity to follow this path, stagnation becomes his lot, the vitality of his teaching declines, and the validity of his knowledge suffers in time.

There is also a practical consideration. In institutions of higher learning, each member generally knows his own field better than any of his superiors or his colleagues within the same organization. Only in the scientific response to published research will such an institution therefore be able to take its own measure, for the guidance of those responsible for its intellectual welfare and its progress. Original research is therefore both the inspiration and the measuring rod of higher education.

The contents of elementary teaching are distilled from the sum total of human knowledge by a process of simplification through omissions. Its illustrations and lessons need only be correct "as far as they go." But there are no omissions behind which ignorance can hide when the Museum presents the actual materials and specimens in their three-dimensional totality, or when it undertakes to reconstruct the entire contents of an environment or the true sequence of a series of events. All levels of education are represented in the audience to which the Museum addresses itself. It cannot afford to allow errors which might create false concepts in any visitor because the visitor was a better observer than the Museum had bargained for. For the proper performance of its role in education, any museum must therefore have at its command a full knowledge of all it portrays, beyond any knowledge obtainable from schoolrooms and textbooks. Its intellectual requirements are those of an institution of higher learning, and only research can insure their fulfillment.

A. E. Parr

Director, The American Museum
of Natural History

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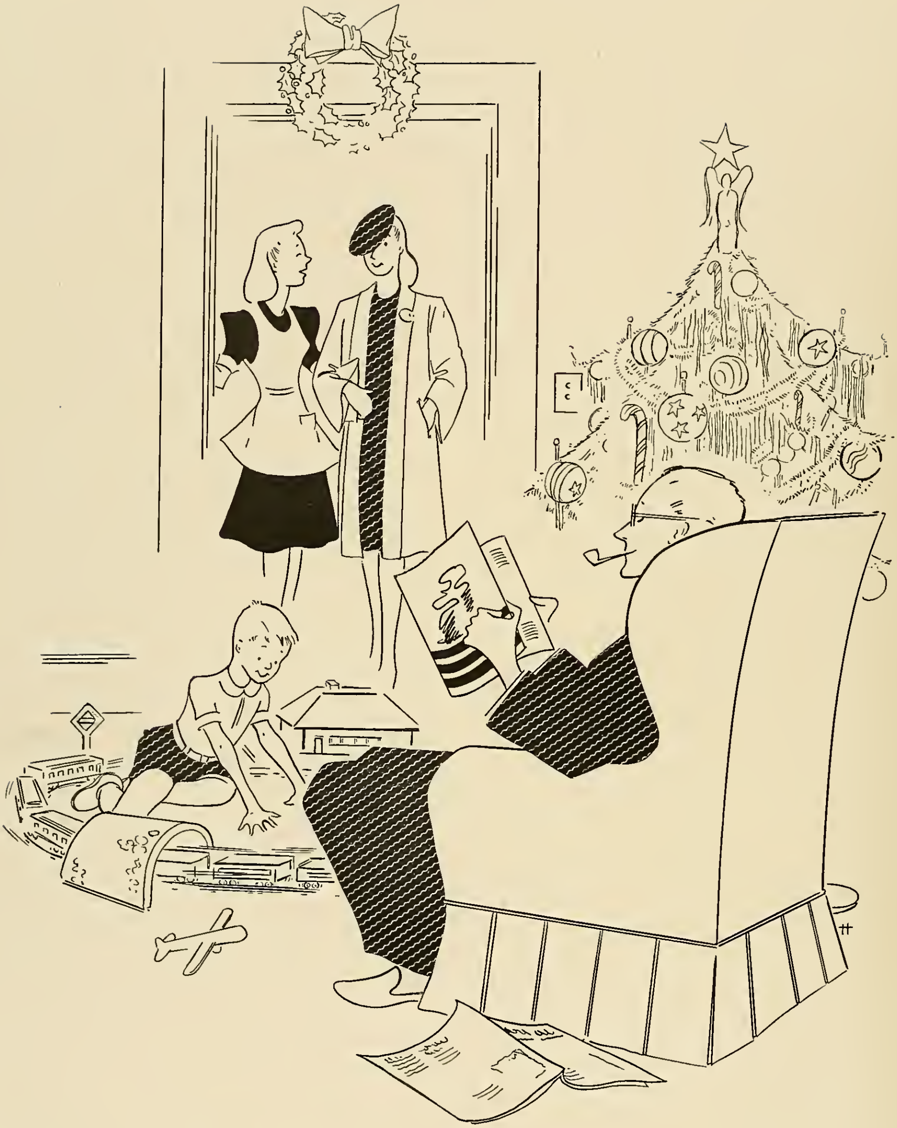

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President
Albert E. Parr, Director

VOLUME LII—No. 4 ★ ★ ★ ★ ★ ★ **NOVEMBER, 1943**

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A bird of tropical America photographed at the New York Zoological Park by Lilo Hess

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You will find Natural History Magazine indexed in *Reader's Guide to Periodical Literature* in your library

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PANGOLINS AS PETS

The animal whose hair has turned into armor plate and which captures its prey with its tongue proves to be one of Nature's most expert "escape artists"

By ARTHUR LOVERIDGE

Curator of Reptiles and Amphibians at Harvard's Museum of Comparative Zoölogy

"ARE there any armadillos in Africa?" The question was put to me by a settler as he walked into my office in the Natural History Museum at Nairobi, in Kenya Colony.

When I replied in the negative, he wanted to know if I was very sure. "I don't wish to appear rude," said he, "but could you show me a statement to that effect in a book? I will explain later."

I showed it to him in a book and then it transpired that a friend of his had the five-foot skin of a scaly pangolin, which he insisted was an armadillo. My interrogator had wagered 75 rupees (then about $24 U. S.) to the contrary. Now he jubilantly departed to the Norfolk Hotel to claim his bet. Presently he returned with the loser, so that the latter might be assured by the printed word. Obviously museums and their libraries do serve a useful purpose, critics notwithstanding!

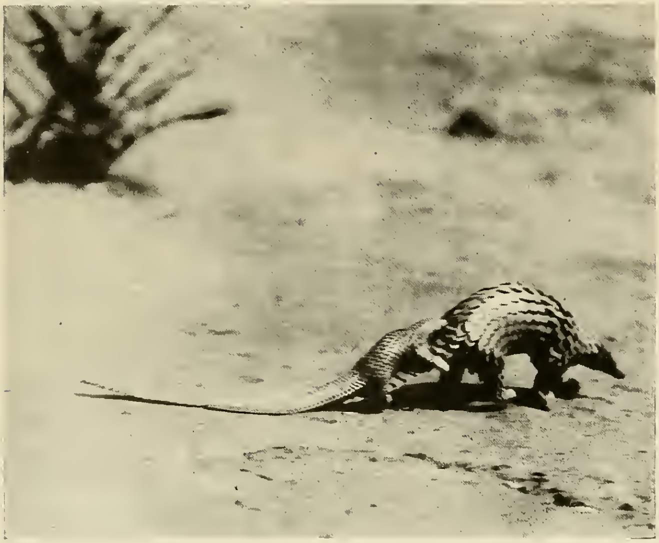
Several years elapsed before I first set eyes on a live pangolin, however; then a native brought one to my camp at Morogoro, Tanganyika Territory, wishing to sell it. An examination of the strange creature now offered me showed that it was covered with leaflike overlapping scales from the crown of its head to the tip of its tail; the snout and belly alone were unprotected. The scales, being formed of hairs agglutinated together, reminded one of the horn of the rhinoceros, which has developed along somewhat similar lines, though in a way less obvious until a section is made and examined under a microscope. The scales of a pangolin are believed to be perfectly soft at birth, only hardening on the second day, while the adult animal supposedly has the power to make them stand out from the body.

It is these scales which are responsible for the inflated ideas some natives entertain regarding the creature's value. Formerly each scale was worth a rupee (32 cents U. S.), for it was commonly believed that a scale worn about the neck protected the wearer from a surprise attack by lions! Many are the superstitions connected with the animal, among which is one that it roars or cries out on hearing rain and, at such times, is so strong that nothing will restrain it. In South Africa, where the creature was once fairly common but is now scarce, the natives credit pangolins with having some influence over their cattle. Therefore, when a pangolin was captured, the poor beast was put on a fire in the cattle pen as a sort of burnt offering to increase the health and fertility of the herd. It has been suggested that this superstition was to some extent responsible for the increasing rarity of the pangolin south of Mozambique. The name pangolin is derived from the Malayan word *pengolin,* referring to the creature's ability to roll itself into a ball.

When all was quiet, my animal cautiously unrolled, revealing a long pointed nose; then it started to trot away on the "knuckles" or sides of its feet. The forelegs looked painfully

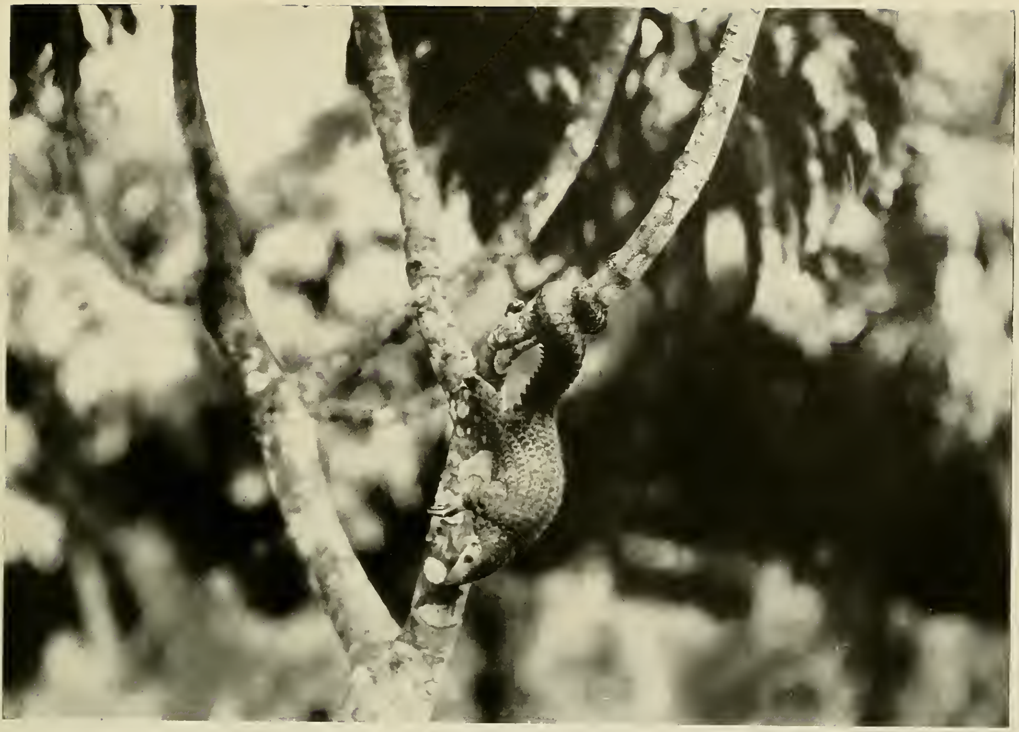
▾ **MOTHER PANGOLIN** permits a hitchhiker even though her own feet are constructed so that she has to walk "on her wrists." At birth, the scales of this curious African animal are believed to be perfectly soft

A.M.N.H. photograph by Herbert Lang



▾ **FROM THE CROWN** of its head to the tip of its tail, the pangolin is armored with overlapping scales. Only the belly and sensitive snout are unprotected

Brian A. Love

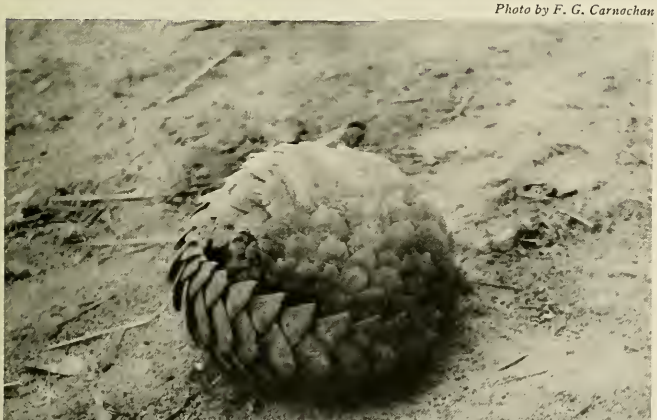


A.M.N.H. photograph by Herbert Lang

▲ THE TREE-CLIMBING PANGOLIN uses its tail effectively in exploring the forests for termites. The under surface of the tail is armed with pointed scales, which support the animal in climbing much like a telephone lineman's spikes

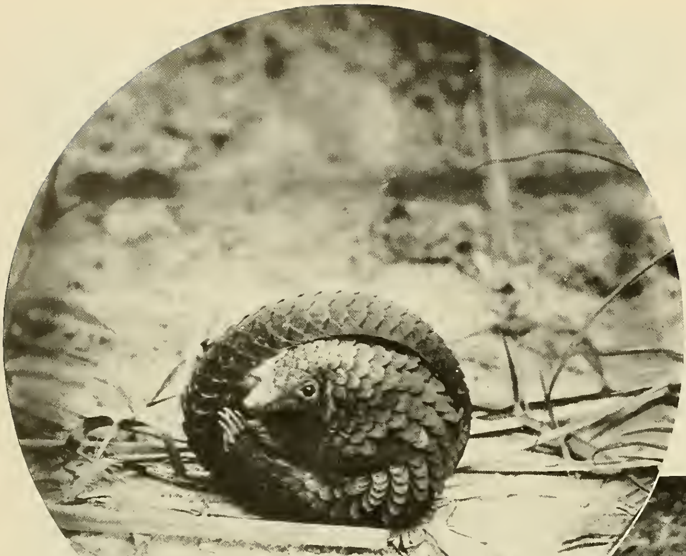
▼ BALLED-UP, a terrestrial pangolin becomes its own fortress

Photo by F. G. Carnochan



awkward, almost as if the pangolin were trying to walk on its wrists, yet despite appearances it managed to move quite quickly. Its claws were enormously developed for the purpose of digging out the termites (miscalled "white ants") on which it subsists, hence the necessity for turning the claws inward when walking. Like the ant bear, the pangolin captures its prey by means of its tongue, which is elongate, glutinous, and rather wormlike. Each time the animal was disturbed by my inspection, it would give a little snort of annoyance and abruptly roll itself up. If I then attempted to pick it up, its armored tail flew around with considerable force, hitting the ground with a resounding whack—when there was nothing else in the way! The action was very sudden, and the animal immediately resumed its defensive posture, burying its sensitive snout in the belly region as a hedgehog would do.

But the vendor wanted 27 rupees for it, a sum I was in no wise prepared to give, so, much to my chagrin, he departed. Five days later he returned, doubtless having unsuccessfully hawked it round the neighbor-



A.M.N.H. photo by Herbert Lang

◄ **The enormously developed claws are used for digging into termite nests. Then a long, sticky tongue darts out to capture the insects**

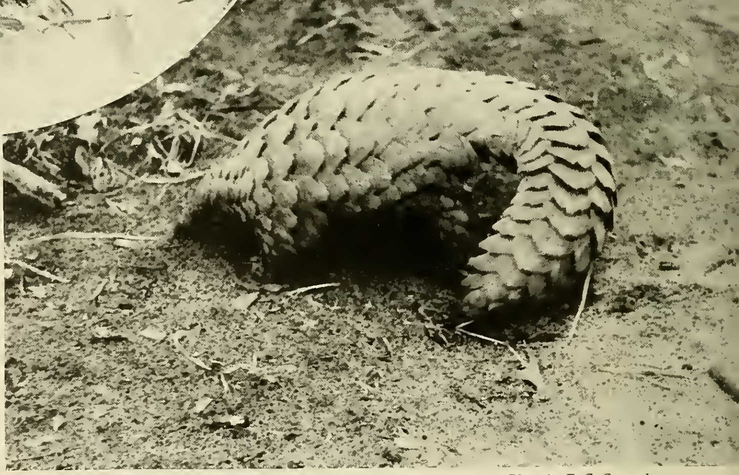


Photo by F. G. Carnochan

▲ **Sudden lashing of the tail causes bystanders to keep their distance. This is the ground-living variety**

hood in the interval. This time he parted with it for a much more reasonable figure. He arrived inopportunely at the close of a busy day, but with the help of my "boy" Salimu I undertook to strengthen a chicken-run sufficiently to retain the animal. We worked for two hours, and darkness fell before we had finished. The pangolin was liberated in the run, and I adjourned for dinner.

As soon as the meal was over I took a lantern and went down to inspect the latest addition to my menagerie. Lo! It was not! In great haste I overturned the straw covering on the bottom of the pen to see if the pangolin was burrowing its way out, though I had taken the precaution of securely pegging wire-netting over the entire ground surface beneath the straw. There was no sign of the beast. Next we turned our attention to the cage itself and so discovered that the creature had made its escape at a height of four feet from the ground at a point where strips of netting broadly overlapped but had been insufficiently secured. Doubtless the pangolin was pleased, even if I was not. Twenty natives, provided with lanterns and stimulated by the promise of a substantial reward, turned out to look for the truant—but without result. The pangolin was never seen again! I was the recipient of much sympathy from my native friends, who told me that it was only to be expected, since nothing would restrain a pangolin after it had made up its mind to depart.

Twenty years rolled by before once again I was the proud, though temporary, possessor of a pangolin. On this occasion I was staying with a settler at Saranda, in central Tanganyika. Remembering past experience, I put the potential Houdini in a packing case, strongly screened across the top with wire-netting. "Even if it climbs the sides and wrecks the netting, it will still be safe," I thought, as I put the case into a small stone kitchen and saw to the fastening of window and door last thing at night.

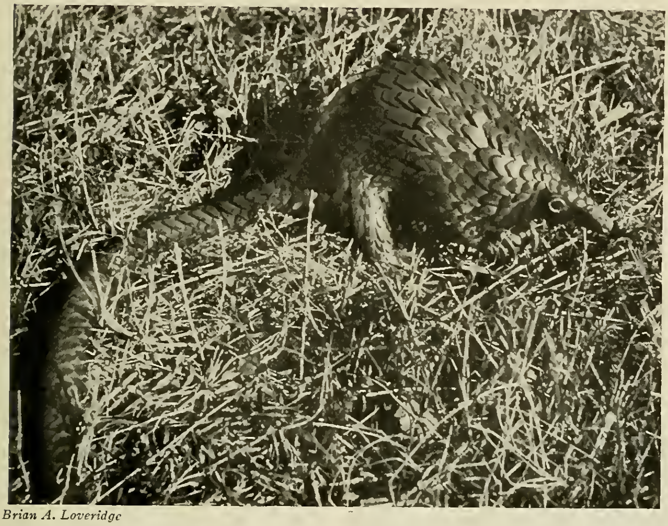
Next morning, however, we soon learned that the pangolin had left. It *had* climbed the sides of its case, then tugged and pushed at the netting until enough nails were loosened to permit it to squeeze out. From the box, it had climbed to the narrow window sill, then reared up to claw at the catch of the wooden shutters which, unfortunately, opened outwards. When the shutters flew open, the pangolin fell to the ground outside. We trailed it for some distance into the bush until we could follow the spoor no more.

Within a month, strangely enough, another of these curious armor-plated creatures came my way. This time I was at Dodoma, some 60 miles south-east of Saranda. At first I fed it on minced raw meat and boiled rice, but it ate so sparingly of the latter that for a time meat alone was provided.

Then it occurred to me that boiled meat and boiled eggs if minced together might adhere to its sticky tongue better than the raw meat. The change was greatly appreciated, and for a time the pangolin ate tremendously. Presently, however, it dropped back to about a cupful per night, which seemed extraordinarily little for an animal of its size—for it was about four feet in length. It drank frequently by putting its long cylindrical tongue into a bowl of water. Often it would poke its tongue through the wire screening of its cage; and it spent much time clawing at the netting in an endeavor to escape. These attempts proved unavailing, for at last I had learned that only the strongest of cages would hold such a creature. Three months later it was shipped to the United States, where it arrived safely.

Besides the savanna-dwelling pangolin (*Smutsia temminckii*) of which we have been writing, East Africa can boast another species. For the arboreal pangolin of the West African forests occurs also in the great Mabira Forest, which covers 128 square miles of Uganda. Cut off from the western forests, this animal appears to be sufficiently different from the West African one to have merited description as a new race, based on a male (*Phataginus tricuspis mabirae*) which I obtained in 1938.

The *lugave,* as this pangolin is called by the Baganda, is immedately distinguished by its long and prehensile tail, doubtless a considerable asset to its owner when climbing about the great forest trees in search of arboreal termites. Moreover, the lower surface of the tail, like that of the great flying squirrels of this region, is furnished with pointed scales, which serve to support the climbing pangolin in much the same way as do the spikes on the climbing irons of an egg-collector. Indeed the hind legs and tail can hold so strongly to a tree trunk that the pangolin, letting go with its forelegs, can lean over backwards almost to a right angle with the trunk. It has been said (but to me this sounds like a native tale) that at times, rather than laboriously descend the main trunk, a pangolin will roll up and cast itself down, erecting its scales so as to break the force of the fall! Those scales which have caused the wearer to be rather aptly described as an animated spruce cone!

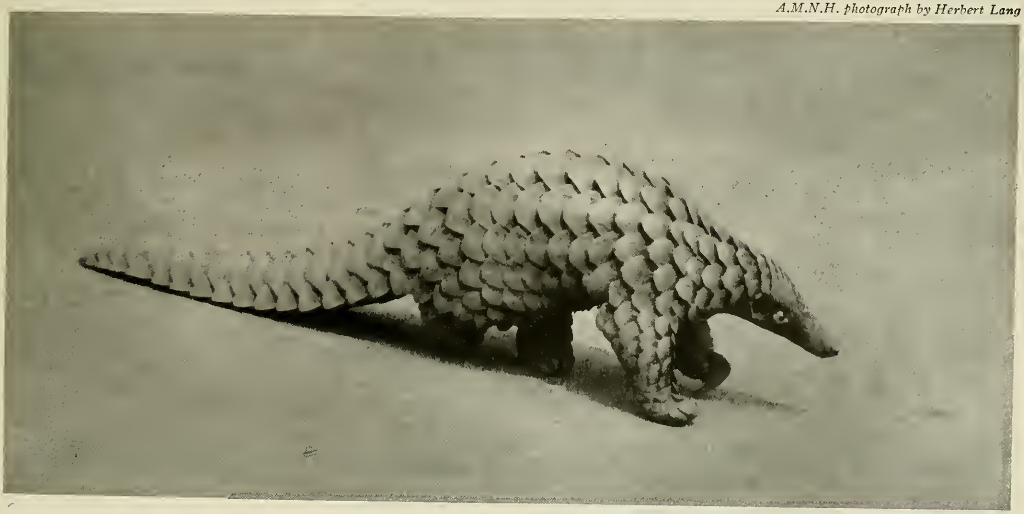


Brian A. Loveridge

◄ THE OVERLAPPING SCALES blend into the landscape a short distance away. The animal is said to have the power to make them stand out from the body

▼ UNCURLING and ambling off, the pangolin has been likened to an animated spruce cone

A.M.N.H. photograph by Herbert Lang



Treasure house of the Sierras

A camping trip along the trails of this newly established National Park reveals it as a shining addition to the heritage that is made permanent for our country in the preservation of its natural wonders

The name of Kings Canyon National Park has such rich associations for those fortunate people who have clambered over its rocky trails or ridden from lush flowered meadows to the very outposts of the sky, that its flavor is like that of no other place—no, not in all the world. One of California's natural treasure houses, it is only after 49 years of effort on the part of John Muir and Stephen T. Mather that a large portion of it has at last been designated as a National Park. Inherent in its establishment is the solemn promise that no roads will climb out of the Valley of the South Fork of the Kings. Therefore, there will be no highways to take away from the grandeur of this primitive area. The present road only approaches the boundaries of the Park. To enter its great wilderness, the visitor must go afoot or on horseback.

Those who know this region of great height and sublime mountain country hunger for the time when they will be free again to pile camping equipment into their car and make for the trails that carry one out of civilization into these vast reservoirs of peace.

Seven hundred and ten square miles of incomparable mountain land, carved by glacial action into the very heart of the Sierra Nevadas' 400-mile length! Imagine three groves of Giant Sequoia trees, four peaks over 14,000 feet, and over 63 peaks over 13,000 feet in altitude. Such a region can be known only from many points, and its trails must be traversed in leisure to be enjoyed. Its streams must be fished to taste its charm.

▼ THE SWIFT WATERS of the South Fork of the Kings rush by as the visitor approaches the point where he will set forth on foot or horseback. A scene near Windy Cliffs in the Kings Canyon Recreational Area

When the Park was created March 4, 1940, the General Grant Park and the Redwood Mountain area were included as the General Grant Section. While they do not adjoin the main section of the Park, they act as a gateway to it from Sequoia National Park or from Fresno. Shortly after leaving Grant Section, a fine state highway brings the traveler to a crest in the Sequoia National Forest where the high country of the Park stands in sublime invitation. Deep gorges and snow-blanketed peaks stretch as far as the eye can see. Thirty-five miles away we view the always arresting summit of University Peak—13,588 feet of granite rising in a glorious climax. This is visible all along the higher part of our route and from many other points in this section of the park. To the northwest the outline of the country around the Middle Fork of the Kings River looms on the horizon, jagged, tumbled, awe-inspiring.

We rolled quietly to the spot where the wonderful road drops into Kings Canyon. First there is the great panorama of snow-covered peaks to entice one with their air of calm detachment and peace. Then, as the nose of the car points down, the attention is riveted upon the juncture of the Middle Fork and the South Fork of the Kings. Coming from "Himalayan" sources, the Middle Fork fights its way through a mighty gorge. The South Fork hides its beauty for a later moment. Together they whirl away to where later the North Fork joins them, and off they go into the San Joaquin Valley and ultimately to San Francisco and the Pacific.

The river below is still a ribbon, a thing upon which you gaze dizzily, trying to guess how far below it winds its tortuous way! Deep into the canyon the road sinks, past the needle points of the high "Windy Cliffs." Not until the road actually crosses it near Boyden's Cave does one come into contact with the life-force that is the South Fork of the Kings. Standing at the edge of the stream, one almost involuntarily draws back, so

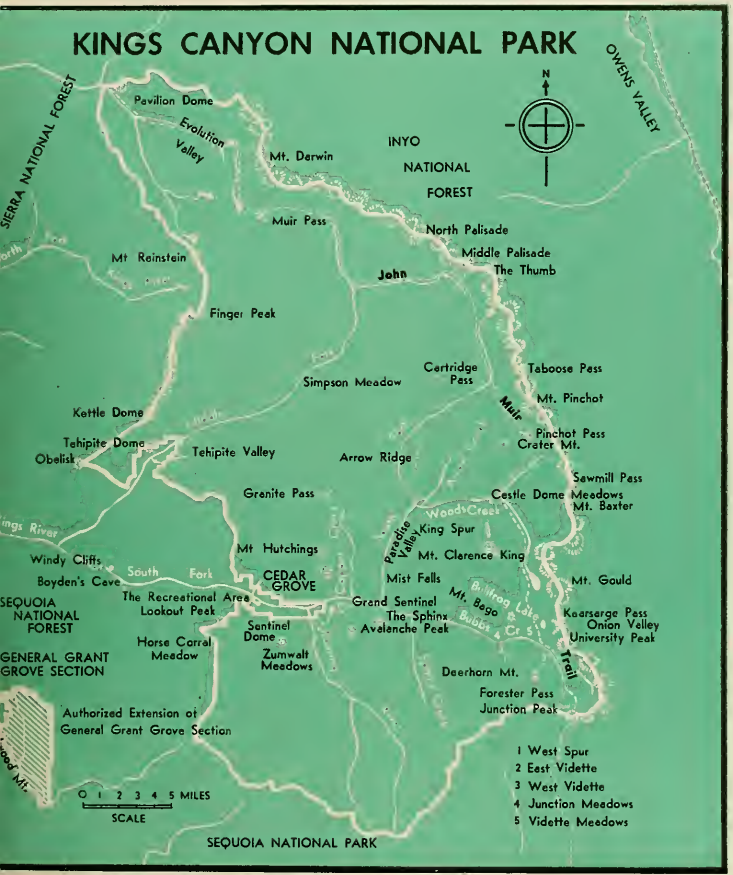
KINGS CANYON NATIONAL PARK

By JOYCE *and* JOSEF MUENCH

KINGS
CANYON
NATIONAL
PARK

▲ PORTAL to an unspoiled wilderness: the sign that tells the traveler he has reached a new wonderland, which year by year will become known to more and more people who love the mountains

▼ ON THE TRAIL to Boyden's Cave: a view of the South Fork of Kings River


KINGS CANYON NATIONAL PARK
SIERRA NATIONAL FOREST
OWENS VALLEY
N
Pavilion Dome
Evolution Valley
Mt. Darwin
INYO NATIONAL FOREST
Muir Pass
North Palisade
Middle Palisade
The Thumb
Mt Reinstein
John
Finger Peak
Cartridge Pass
Taboose Pass
Simpson Meadow
Muir
Mt. Pinchot
Kettle Dome
Pinchot Pass
Crater Mt.
Tehipite Dome
Obelisk
Tehipite Valley
Arrow Ridge
Sawmill Pass
Granite Pass
Castle Dome Meadows
Mt. Baxter
Woods Creek
Kings River
Paradise Valley
King Spur
Mt Hutchings
Mt. Clarence King
Windy Cliffs
South Fork
Boyden's Cave
CEDAR GROVE
Mist Falls
Mt. Gould
SEQUOIA NATIONAL FOREST
The Recreational Area
Lookout Peak
Grand Sentinel
Mt. Bago
Bullfrog Lake
Kearsarge Pass
Onion Valley
The Sphinx
Avalanche Peak
Bubbs Cr
University Peak
Sentinel Dome
Horse Corral Meadow
Zumwalt Meadows
GENERAL GRANT GROVE SECTION
Trail
Deerhorn Mt.
Forester Pass
Junction Peak
Authorized Extension of General Grant Grove Section
1 West Spur
2 East Vidette
3 West Vidette
4 Junction Meadows
5 Vidette Meadows
0 1 2 3 4 5 MILES
SCALE
SEQUOIA NATIONAL PARK

▾ MIRRORED in the calm waters of lovely Lake Hume one sees the rugged peaks of the Middle Fork country. The Sequoia trees in the left foreground may some day be giants, in the land where time is forgotten

great is the force and energy of the flow of water. Every stone in its way seems to drive it to new rage, as the water whips itself to a continual fury of white. Like a magnificent beast beside itself with anger, it shakes the earth with the power of its lashings and fills the canyon with the echo of its mad voice.

Already one is enchanted with this country. The eye first watches the noisy river lest it slip its leash and grab at the unwary; then your gaze seeks the cliffs and rises bounding to great heights. Here are sharp points that pierce the sky and green shelves where the Yucca laughs at the dizzy cliffs and the river below. We climbed to one of them, first zigzagging across a slippery patch of dried grass, white beneath the June sun, and then over some loose shale to a comparatively safe place to catch a picture. Two tall specimens of the Lord's Candle rose from separate rosettes close together. About 10 feet in height they were—fragile chalices of light, their great panicles of bloom fittingly set in this canyon.

The road winds through the gorge, climbing gradually, and the river cavorts and throws itself about, only occasionally smoothing out as though too exhausted for the moment to do anything but move quietly.

The highway ends at Cedar Grove, and a little beyond begins the Park proper, a region traversed only by trails. The ten miles of road along the river are part of the Kings Canyon Recreational Area, which is not in the Park but by agreement with the Forest Service is administered by the Park Service. A glance at the map will show a long narrow piece of land that has been withheld from the Park as a possible reservoir site in this canyon.

The Valley of the Kings is 4600 to 5000 feet above sea level, while on either side rise mighty cliffs. These lift beyond in a complicated series of ridges and basins embracing in all some 450 square miles that empty their streams into the valley. So that all along the road and then the trail, gladsome streams can be seen dripping from the cliffs into the already vigorous stream of the Kings River. The trails lead through bowers of whispering pines and firs and sunny open places, flowered meadows and closely shuttered lanes where alders, willows, and fern brakes make beautiful settings for the flowers of spring and summer.

Roaring River enters the South

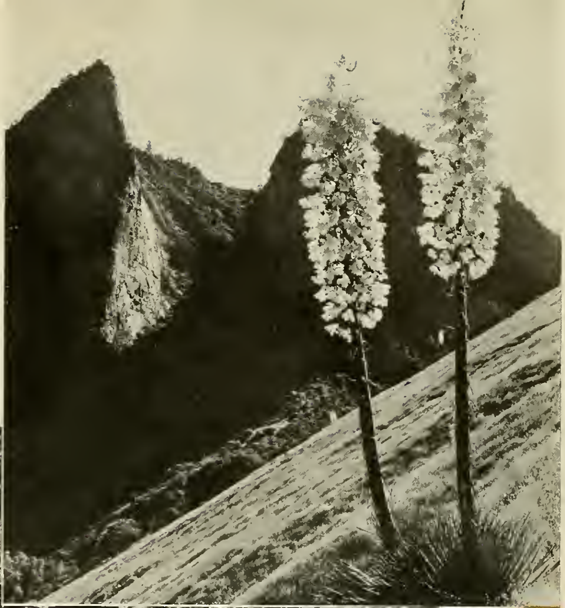
Fork from the south side as such a powerful stream in itself that one would expect it to swell the Kings past the bursting point. A bridge, sturdily made with big logs, spans it, and one can stand upon it and defy the swirling white waters that reach up as though to pluck the saucy pigmy from its place of safety. Here we glimpsed the cheery water ouzel, darling of the waterfalls. One moment he was bobbing and dancing among the rocks; then, swiftly following in flight the bend and drop of the water, he was gone like a phantom, as though into the white stream itself.

The Zumwalt Meadows spread out to the very edge of the great cliffs, full of flowers and marshy growth, while Grand Sentinel stands above in its monumental strength, shrinking man to ant-size. But on every side new beauties unfold, and soon the noise of Copper Creek, bursting into many small streams in its great haste to join the river, adds to the clamor of the Kings itself. The trail pushes its leisurely way on and on, climbing steadily to where the bridge crosses the river beside the junction of Bubbs

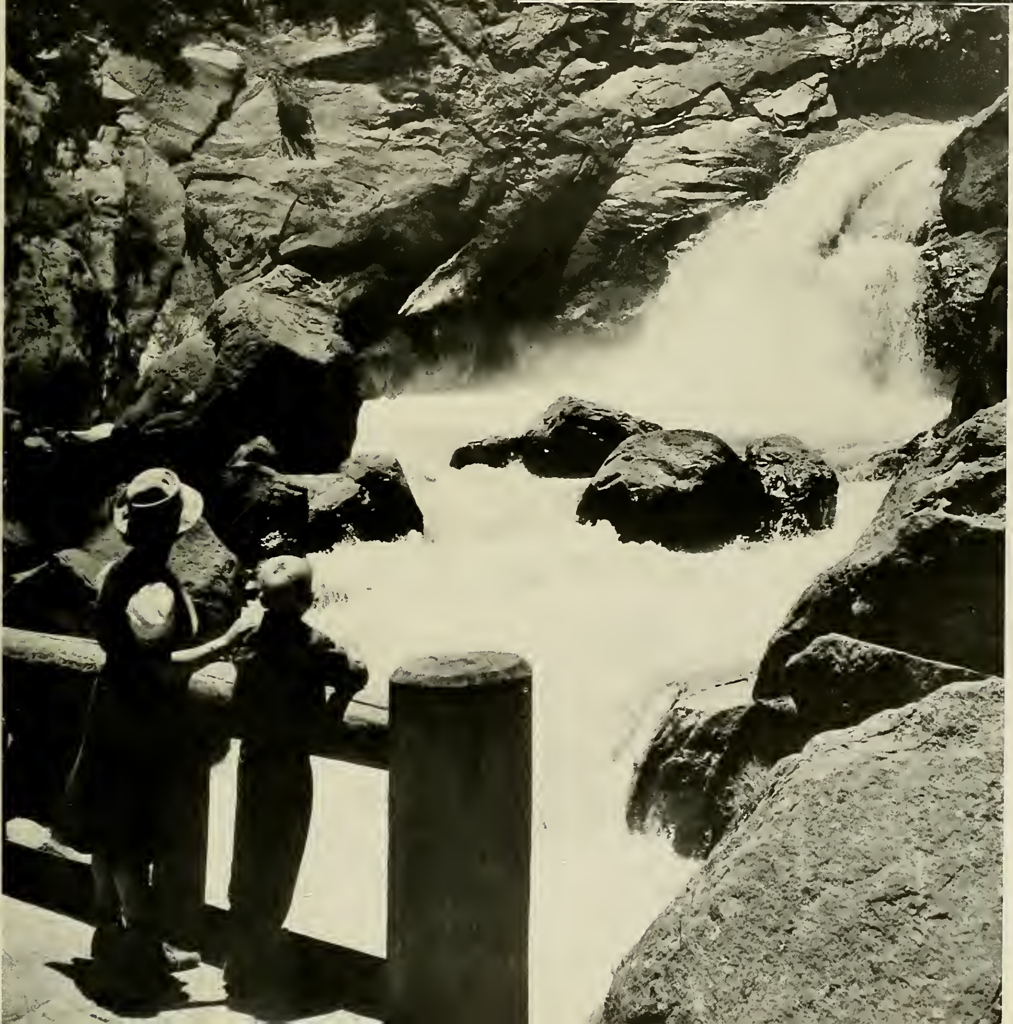
▲ GRIZZLY FALLS: a delicate cascade with a menacing name. In bowers like this, many birds add their voices to the rushing of the water, and the nature lover has good opportunity to study woodland life

▼ FAR from the cares of community life, this clear-flowing mountain stream is typical of many that lure the fisherman to the wilderness in this section of California

➤ BEAUTIFUL panicles of *Yucca Whipplei* attract the interest of the botanist on a steep slope looking across to Windy Cliffs in this section of the Recreational Area adjoining Kings Canyon National Park



▼ A STURDY BRIDGE permits a view of Roaring River at close quarters. One almost hesitates to stand in the presence of its living force, as the water, making a sharp bend through a narrow gap, screams as though in disapproval at having to go around an obstacle



◄ TREES, CLOUDS, and surprising walls of rock offer innumerable views for the cameraman in Paradise Valley

▼ A WINDBLOWN WHITEBARK PINE persists against the elements almost at timber line in Kings Canyon National Park. In the distance rises the ragged crest of Crater Mountain

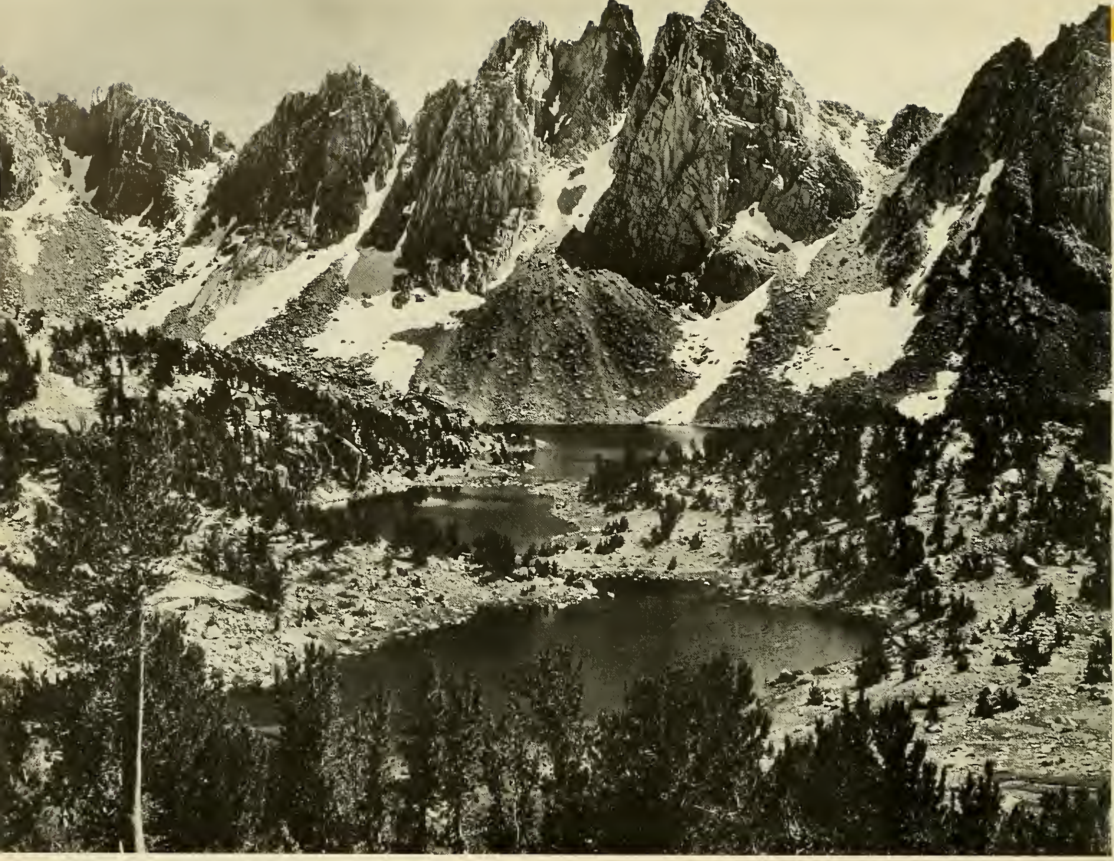
▲ MAJESTIC UNIVERSITY PEAK: a part of the beautiful chain of lofty mountains that make up the eastern scarp of the High Sierra. Rising above lingering summer snow fields, its rugged crags and spires pierce the limitless blue to an altitude of 13,588 feet

Creek. Here the trail splits and we follow up Bubbs Creek.

After crossing the creek several times over low bridges, switchbacks begin to pull the trail swiftly out of the valley. At every turn the view back into the Canyon of the Kings becomes more magnificent. Then the next turn yields a vista up Paradise Valley where the main river comes down from the north. The walls of the canyon appear in profile, like graven giants guarding the path of the river that is remote and quiet in the distance. Climbing from 5200 feet at the Paradise Valley Trail junction, we have reached 6500 at Sphinx Creek Trail. Above us the Creek

BENEATH MIGHTY CLIFFS, the ice in Kearsarge ake yields gently to the summer sun: another reath-taking view in the region opened up two ears ago under governmental protection

▼ BURROS carried the provisions, so the hikers were able to enjoy the full pleasures of this invigorating wonderland. Beyond Bullfrog Lake may be seen the amphitheater of Mount Bago. This is a glacial cirque, which in the Ice Age was the birthplace of a glacier



▲ FROM JEWEL-LIKE LAKES, the eye rises over aprons of snow and rock to the towering Kearsarge Pinnacles

seems to be falling headlong over the canyon walls in what looks like a leisurely drop, belied only by the white foam into which the water is lashed in its plunge. The next seven and a half miles of trail go through pine-clad hills with occasional meadows, all lifting tirelessly as though striving toward the peaks that keep the eyes straining upward. Massive Lodge Pole pines are found here, particularly at Junction Meadows, where the elevation and precipitation appear to be ideal for them. Birds are everywhere, singing and flying in such numbers that they fill the atmosphere with their joy. The California mule deer leaves his track upon every trail and can be seen particularly early in the morning and in the evening. This is the haunt of the black bear and all the lesser folk of the forest—the coyote, the fox, the squirrels, and the chipmunk. Even when they do not show themselves there are many signs of various animals.

The two miles between Junction Meadows and Vidette Meadows are mostly up. A great talus slope is crossed, with Bubbs Creek frothing through the rocks and roaring as it gleefully makes its escape into lower canyons. Now the peaks all around are to be seen more clearly, and one is conscious of the elevation in some subtle way. The air seems clearer, and the world gleams like a new thing. At Vidette Meadows the stream wanders through flat land, to the delight of the fisherman who will come many miles to cast his line in these waters; and beyond, the walls of the mountains go up breathlessly. East Vidette, that perfect mountain with the shape of a freshly made cone, rises in sharp lines to its fragile peak 12,742 feet above sea level. Behind it is East Spur, leading up to Deerhorn Mountain. This peak in turn sends forth the West Spur, which terminates in West Vidette (12,229 ft.), on the other prong of the antlers.

The John Muir Trail, which comes in here from a succession of wonderful peaks and inspiring vistas to the south, traverses the main section of the Park from south to north and is the main summit-trail route between Sequoia National Park and the Yosemite Valley. It was named after the famous naturalist and founder of the Sierra Club, who so passionately loved this region and foresaw its value for future generations. To the east the Kearsarge Pinnacles look blunt and heavy. Their finely-cut features are best seen from the north. Every foot of climb in the trail is rewarded by the increasing beauty of the view of the Videttes and the Center Basin Country, with Center Peak looming in the background.

Bullfrog Lake is reached at 10,634 feet. Now we are almost at the timber line. The incomparable forests that rise to about 8,000 feet and include thirteen conifers and as many broadleafs, are gone. In keeping with the rugged, naked rocks and peaks are the shorter and stouter trees that show their struggle in irregular branches and twisted grain. The Jeffrey Pine and the Sierra Juniper perch on high ridges, and the Whitebark Pine lies prostrate upon summit rocks as though hurled there by the heavy winds. Even in the latter part of June there is snow all around. It is melting away on the meadows except for the slight freezing over during the cold night, but there is a feeling of being "up in the snow." Peaks of 12,000 and 13,000 feet are in the vicinity, each with its own bold outline, its own majestic grace. There are the serrated crags of the Kearsarge Pinnacles, with their several lakes clinging to their stony knees, as it were, and Bullfrog lying at their feet. The East and West Videttes rise clearly into unbroken sky, and Mount Bago (11,868 feet) with its ring of peaks like the beads on a necklace fills the sky to the west. Mount Gould completes the circle around the lakes, and up its flank climbs the trail to Kearsarge Pass at 11,823 feet. From there one can drop down in a few short miles to Onion Valley and thence to Independence in Owens Valley. The eye can sweep not only over the high country of the Kings, where Bullfrog Lake looks like a four-leaf clover, but eastward down the slope of the Sierras and out to Owens Valley, which ends mistily in the desert mountains hiding Death Valley. We can even see beyond these ridges to Nevada's peaks—a view sublime in its beauty and breath-taking in its distances.

Dominating the landscape from every point and now clearly to be seen is University Peak itself. During all of the 35 airline miles from that distant highway, this view had lured us. Sunset flushed each ridge with pink, then all was dark. The peak was the first point to catch the morning light and glowed like a lamp of hope in a cold dark world; all day it seemed to catch the spirit of the changing light and rising wind.

We retraced our steps to Vidette Meadows and then down to the Kings again. A little later in the season we could have gone over Glen Pass to make a circle and come down through Paradise Valley.

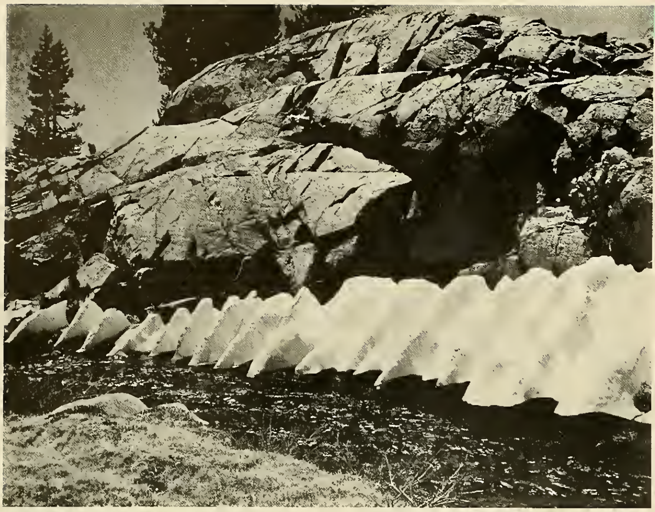
At the junction of Bubbs Creek we turned right and followed up along the west side of the Kings. The trail climbed gently but firmly, always accompanied by the voice of the river. Every so often we went through cathedral arches of trees. The roar of the river died away to the muted background music of a great organ, and from the throat of a bird came an ecstatic, flutelike song to carry the melody.

In low places the whole scenery within the background of the trees changed. From a dry sandy trail covered with oak leaves or pine needles, the footing became moist. Fern brakes added a light green, and flowers peered expectantly from everywhere underfoot. Sego lilies, Indian paint brush, Brodiaea, and a host of other spring things grew abundantly. The white bloom of the thimble berry and the wild cherry were there, likewise milkweed with its dropping head, and every so often, the lovely saprophytes.

The way became steeper, and the river echoed the rise in elevation in its greater noise and speed. As we kept rising and climbing the talus slopes, with the walls of the canyon pressing on our left, we came to Mist Falls.

▼ **East Vidette** beckons the mountaineer on this section of the John Muir Trail

↘ **Vidette Meadows**, with West Vidette commanding the scene from an altitude of 12,229 feet. Here Bubbs Creek provides a paradise for fishermen as it meanders through the meadow



▲ DESIGN IN SNOW. As though to uphold the tradition among so many other natural beauties, this drift beside a mountain stream grows old gracefully and provides an unusual spectacle for the passer-by

▼ ABOVE the zone where trees of lesser stamina succumb, this fallen monarch lifts its arms defiantly against the mountain sky

Here in a series of drops the river tumbles from one ledge to another with such force that sheets of spray are thrown into the air. I have never seen water throw itself with such abandon; surely every single droplet of it is torn asunder as it hits that last shelf of rock and rises in a cloud like a living thing, bathing the whole vicinity in moisture. There are several places where it is possible to walk out to the very edge of the water and watch it flinging on its way, but so great is the force, so determined the movement, that one draws back afraid. Freed from long winter captivity in snow upon the mountain slopes the water seems to glory in its freedom and power to move; and no words or pictures can show its naked force.

At about 6500 feet we entered Paradise Valley and followed along the South Fork for another four miles. A delightful variety of changes was rung on the same pattern that we had seen before, with meadows, pine-cov-

ered slopes, gently rising hills, and talus slopes with brisk switchbacks. Always there was the feeling of rising, if not on wings, at least most determinedly on our own feet to the promise of ever more beautiful sights. As we took a short detour up the side of a hill to avoid a fallen tree on the lower level, a deer was startled out of the brush by the sound of our feet. Though evidently in no great fear, it put on an astonishing exhibition of its ability to escape. It was a breath-taking sight to see the animal clearing logs with the lightness of thistledown and moving through tangled brush as though there were nothing there. At a delightful camp site close to the Kings River we spent the night, lulled to sleep by the steady drum of water hastening on its way. Arrow Creek could be seen as it made its leap from the very top of Arrow Ridge, like a white mask over the cliffs, where imagination easily painted the winking eye of an old man.

At the ford next morning the sturdy little burros went into the swift current with only a little urging and then carefully picked their way across to safety. The foot bridge we crossed was a good-size log about half a mile up stream. Now following Woods Creek, we climbed steadily through Castle Dome Meadows on up to where we meant to cross the Creek. The footbridge had been washed away, so instead we followed the north bank of the Creek up to about 10,000 feet, where we could see Mount Baxter, Crater Mountain, and the Pinchot Pass. At this altitude the marmot dwells in talus rocks close to the water, and the tiny pika or cony makes hay while the sun shines, carrying grass to his winter storehouses. The Clark Crow screams among the stunted juniper trees, and the wind howls through the great passes of the high mountains. The interesting slopes of King Spur guide the eye up to the peak of Clarence King, and untold beauties lie behind those ridges—more lakes and rivers, more quiet meadows and myriad water falls.

We watched the glorious sunset, reflected on the mountain peaks, and we wished that we might live up here remote from strife and confusion.

Retracting our steps we saw again the things we had enjoyed so much before. The thrill of crossing the wild swift waters again without losing a bag or camera, the ease of dropping down the slopes we had struggled up! Out of Paradise we came, reluctantly, past Mist Falls, and back to earth. The burrows, "Buck" and "Pete," hurried as they approached "home" at Cedar Grove, and they were accorded a most hilarious greeting by their fellow burros.

To us, those trails will always beckon. Cold nights, the tiredness that comes from long jaunts in the open, the hunger that is amply satisfied around a cheery fire, are part of our desire to look those peaks in the face again and to live among them.

Through war and the struggle to re-establish a lasting peace, the comfort can be ours of knowing Kings Canyon National Park, even while we cannot see it again. For here is such beauty as man forever strives toward and an elemental strength of form that uplifts the mind and cleanses the spirit. It still awaits us while the world rocks in conflict. In sight of these towering slopes and rushing streams the earth cries out—"Give me men to match my mountains!"

◄ **Homeward bound** from the high country of Kings Canyon National Park, the trail takes the campers down toward Cedar Grove and the motor road

Tools for Carpentry

versus combat

By S. HARMSTED CHUBB *

Research Associate in Comparative Anatomy,
The American Museum of Natural History

We have long been told that Nature provided the beaver with teeth that are automatically kept sharp through use. Actually he has to spend considerable time deliberately sharpening them, and you can see a squirrel doing the same thing

POSSIBLY the carpenter enjoys one of the oldest and most honored crafts. His work requires intelligent skill plus perfect tools.

The carpenters, lumbermen, or, if you please, the hydraulic engineers along the wooded banks of our lakes and streams, the beavers, work in a somewhat similar manner in some strange way without the intelligence of the human carpenter. They have the most excellent tools for their comparatively limited purposes, and marvelous power to operate them efficiently.

The beaver undoubtedly has difficulties to overcome. But, like the human carpenter, he deals with inanimate material that does not struggle violently to resist his best efforts. While hard wood might be said to offer resistance, that resistance is of a definitely known character and vastly different from the surprise moves and violent struggles of a 12-pound salmon, or of a 700-pound zebra stallion with which a lion must needs reckon while hoping for a much needed meal. Therefore, the beaver, like other rodents, is provided with four beautifully specialized chisel-like incisor teeth, with a hard enamel band on the forward surface while the greater proportion of the tooth is of softer dentine.

Whether the life work of the rodent happens to be hewing down forest trees, browsing on their smaller branches and building dams, or penetrating the hard shell of a hickory nut, the requirements are similar. A rodent may prefer to excavate a leak in the corner of the farmer's grain bin, or—like the porcupine—to exercise his sculpturing talents on the floor beams of a summer cabin, but the "tool chest" is always basically the same.

Tools must be kept in good working order. A chisel must be kept sharp. It has always been assumed that the chisels of beavers, squirrels, and other rodents are automatically sharpened while the animal uses them. A tool that would continually grow sharper instead of duller would be an invention that man might profitably borrow from the beaver, but this is not really the case. I believe it can be shown that in the care of his tools a beaver or a squirrel is much more like a human carpenter than we have supposed. In short, that he deliberately sits down and sharpens his chisels at intervals.

The jaw of a rodent is very loosely hinged, so that if the animal had to engage in violent combat, like a lion, tiger, or puma, this jaw would be subject to serious dislocation. But it is this apparent weakness that gives the rodent its ability as a wood carver. The looseness of the joint gives the jaw an immense range of forward and backward movement, fully ⅞ of an inch in the case of the beaver. When a rodent is passing the time in tool sharpening, he thrusts the lower jaw forward and upward. Then with a vigorous up and down movement he chisels away the softer dentine from the back of the upper incisors with the hard enamel edge of the lower teeth. Thereupon the operation is reversed. The jaw is moved still farther forward and in a similar manner, with a somewhat more diagonal movement, the superfluous dentine at the back of the lower incisors is carved away by contact with the upper enamel edges, as shown in the illustration. While the dentine reinforces and supplies the necessary strength to the tooth, the sharpening operation results in a perfect chisel-shaped tool without unduly reducing its strength.

Perhaps you have watched a grey squirrel, as I have often done, sitting on a branch after his meal, busily engaged in tool whetting. It is even more spectacular to see a porcupine standing erect on his haunches rapidly vibrating his jaw and "to hear the sound thereof," as this is quite a noisy operation and cannot be mistaken for the slower and more irregular sound of gnawing. This music resulting from tool sharpening is often heard at night just outside the canvas wall of one's tent.

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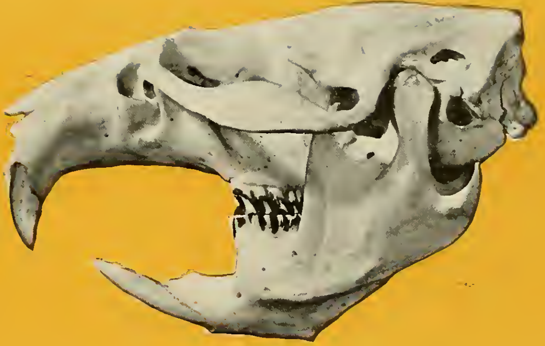
*S. HARMSTED CHUBB has been associated with the American Museum of Natural History for many years and has many reputations. He has contributed greatly to the science of comparative anatomy; he is an outstanding authority on the horse; and, not least, he is widely esteemed as a master of the art of conversation. His special field of study has been the evolution of form and movement in animals, and the exhibits he has constructed for public display in the Museum have won him lasting recognition for scientific precision and artistry. The present article on the jaws of animals reveals one aspect of a subject, which, like most of his other professional activities, has fascinated him from boyhood.—ED.

If there is any slight irregularity in the enamel edge of the tooth, it leaves its mark upon the opposing dentine, as can be seen by examining rodent jaws. Furthermore, in the case of the capybara of South America, the largest living rodent, the normal shape of the enamel is quite distinctive, there being two convex surfaces separated by a vertical groove. This contour is clearly impressed upon the dentine at the back of the upper and lower incisors as a result of constant tooth sharpening. With rodents in general the surface of the dentine, where it is carved away by the opposing teeth, tapers in a slightly concave surface from the cutting edge of enamel toward the gum-line, though this does not apply so perfectly to the capybara. In some species, the muskrat for instance, it is carved away even slightly beyond the gum, as shown in the accompanying drawing. This point could be reached only by the opposing teeth and, of course, could receive no wear during the gnawing process or while chewing. Notice in the illustration how the upper and lower incisors are not in contact when the back teeth are in position for chewing.

The gigantic extinct rodent *Castoroides,* almost as large as a black bear, shows the same systematic carving away of superfluous dentine in prehistoric times. In the dentine of the upper incisors far above the cutting edge of enamel there is an excavation approximately one-half an inch deep, which bears the unmistakable tooth marks of the lower incisors and obviously could not have been made during gnawing operations.

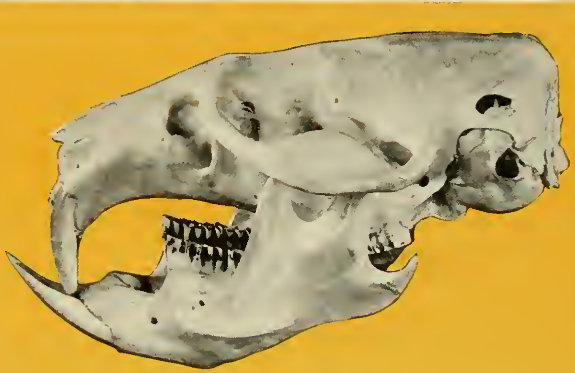
Hence it seems clear that the rodent's "chisels" maintain their high degree of perfection by deliberate and systematic sharpening rather than by wear, as stated by many eminent writers.

The constant wearing away and resharpening of these tools naturally consumes much material. This is adequately provided for by the continuous growth of the teeth throughout life. They move forth from their sockets fast enough to compensate for the wear and sharpening. In fact,

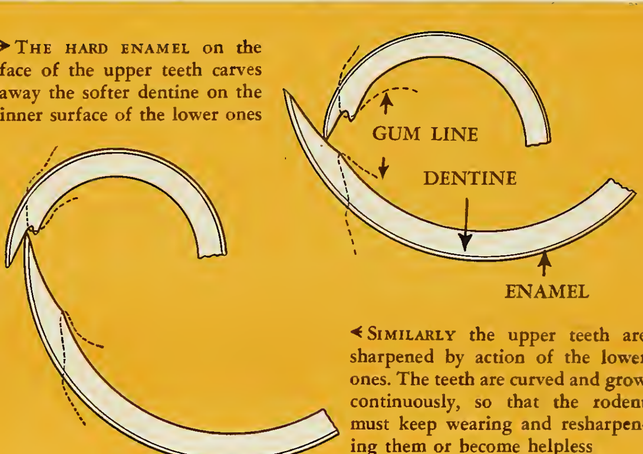


▲ **RODENTS could not keep their teeth sharp if their jaws were not so loosely hinged. When the muskrat's jaw is in position for chewing with the back teeth as shown above, the chisel-like incisors do not come near each other**

A.M.N.H. photos



▲ **BUT the animal is able to swing the jaw far forward so as to sharpen the lower teeth against the upper, and vice versa. Note how far out of position the chewing teeth are when the sharpening process is going on**



➤ **THE HARD ENAMEL on the face of the upper teeth carves away the softer dentine on the inner surface of the lower ones**

◀ **SIMILARLY the upper teeth are sharpened by action of the lower ones. The teeth are curved and grow continuously, so that the rodent must keep wearing and resharpening them or become helpless**

Drawings by Helen Ziska

some of the rodents have gone so far as to apply this bright idea to the grinding teeth as well, for example the beaver, capybara, gopher, guinea pig, and others.

The enormous family of rodents, as a rule, are not aggressive, asking only to be allowed to gnaw their way through life as they may find most expedient. How vastly different is the life of the carnivore, which must be constantly ready to attack. His life depends upon successful combat, and his canine teeth (which are absent in the rodents) are highly developed for seizing and killing prey. While the carnivore enjoys the full quota of twelve incisors, they are small as compared with the rodent's four enormous, highly specialized and continuously growing incisors. The cheek teeth are adapted to the mastication and shearing of flesh, particularly those of the cat family, *Felidae,* in contrast to the grinding of vegetable matter among the rodents.

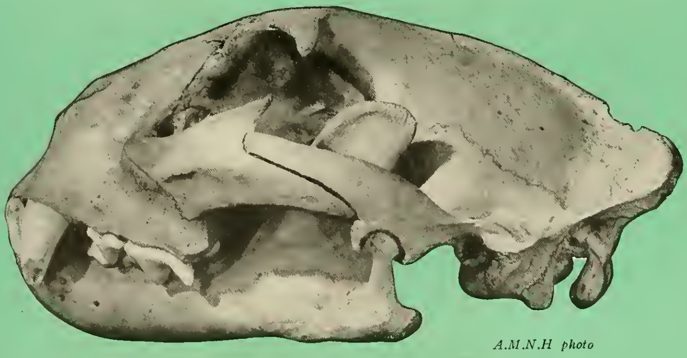
An equally interesting difference is found when you compare the extreme mobility of the rodent's jaw with the strong hingelike joint of the carnivore, as shown by the illustration of the puma skull. While the puma jaw permits a much wider gape than that of the rodent, it is quite devoid of the forward-backward movement so essential to the carpentry work and tool sharpening of the rodent. Also the lateral movement, common to most of the plant eating mammals, particularly to the ruminants, is absent in the carnivores, whose jaw might remind one of a well-hinged barn door with wide and adequate swing in the essential direction, while otherwise restricted. This construction also renders dislocation during violent combat practically impossible. In fact, in dissecting a specimen it is extremely difficult to separate skull and jaw. In the badger and at least one of the otters the jaw is so well secured that it is generally quite impossible to detach it without breaking or sawing the bones.

How pleasingly consistent these facts are! They seem quite as they should be. How gratifying when the facts support our carefully studied theories. But occasionally, as if we had carried our research a little too far, we are confronted with a puzzling condition which disturbs our peace of mind, or is it our egoism? The teeth of the giant panda are of an omnivorous type, yet when we examine the skull and jaw we would certainly conclude that his life must be one of continual and hazardous struggle with creatures almost or quite his equal in fortitude and anatomical perfection. There is an enormous zygomatic arch for muscular attachment and a well locked hingelike jaw articulation, both of which are characteristic of carnivores. But what is the panda's chief food supply? Young and tender, non-resistant bamboo sprouts. True, he may sometimes be reduced to the more mature stalks, the surface of which is extremely hard, but like the beaver's tree trunk, they do not fight back. At the New York Zoological Park pandas consume great quantities of celery, corn meal mush, and bamboo sprouts of domestic growth, but decline the offer of meat; and in his native land the giant panda appears to be a vegetarian.

It is conceivable that in the course of only a few thousand years the panda might have completely changed his diet, whereas probably a radical change in anatomical structure would lag far behind. If anyone will offer a legitimate escape from the cul-de-sac into which I have fallen by mentioning the hingelike jaw and zygomatic arch of the giant panda in this connection, it will be most welcome.

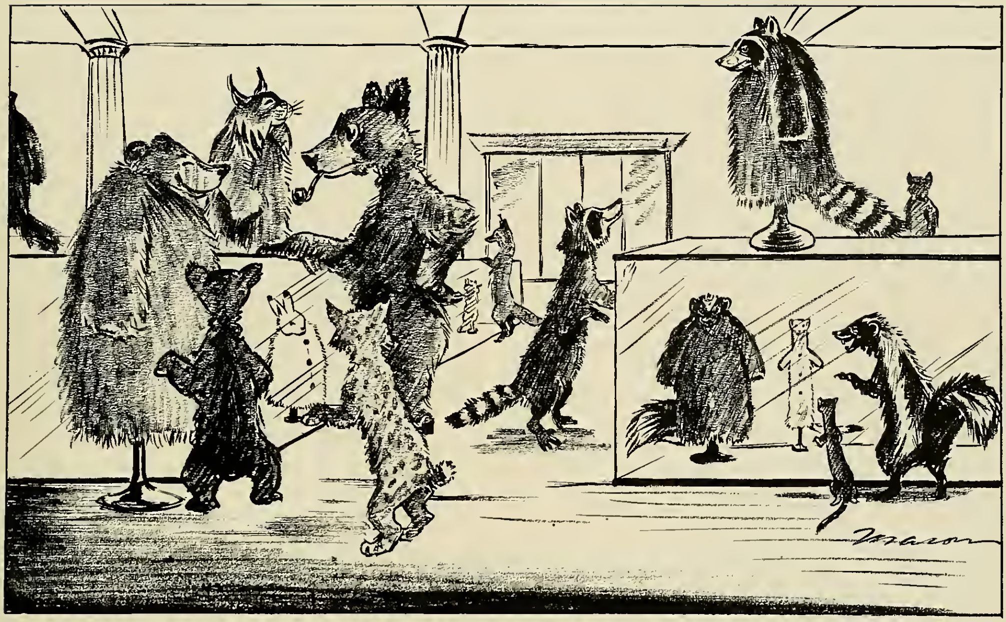
Meanwhile, in any event, the nature lover may find pleasure in observing a squirrel or beaver deliberately sharpening his teeth—an accomplishment for which these diligent animals seem not to have been given proper credit.

▼ **Predatory animals** like the puma, on the other hand, are built for combat instead of "carpentry." They have strongly hinged jaws that permit no forward and backward movement. A rodent's jaw would be dislocated if used for the same violent purposes



A.M.N.H photo

WINTER COATS



By JOHN ERIC HILL
Drawing by
G. FREDERICK MASON

As the cold weather draws near, the fancies of many a young woman turn to thoughts of a new fur coat. The mammals of forest and field always get new coats, war or no war, and without worrying about prices or fur taxes, for they grow their own. By autumn the summer coats have worn and faded, and even when new the summer coverings are less well supplied with woolly underfur than the mammals need for winter. The old hair gradually loosens up and falls out while new hair grows in. Most mammals do not change their fur only in the fall, but also in the spring.

Hair and fur are characteristic of mammals. No other animals have hair, and all mammals have some hair, even if they have no more than an elephant does or, like the whales, only peglike bristles on the upper lip. Hair, like our fingernails, is a growth of the skin, and is built of dead horny cells by a tiny "factory" in the hair-follicle. Hair may be coarse like the hair of an elephant's tail, the bristles of a boar, or the mustache of a walrus. Or it may be fine, like the microscopic hairs of fine wool or the underfur of a beaver.

Commercial fur may include the entire pelage or hairy coat of a mammal, but sometimes the long coarse hairs are removed by processing. The roots of the long hairs are imbedded deeply in the skin, and shaving down the inner side of a pelt cuts off these roots, letting the hairs fall out. The shallow-rooted underfur remains solidly attached. Beaver, sealskin, and other furs are treated this way. Raccoon, fox, mink, and lynx are entire pelts.

Many mammals that live where the snow remains for several months change color in winter. Such animals are active during the cold season, and most of them are small and have sharp-eyed enemies, so the color change is thought to be protective. The varying hares, better known in this country as snowshoe rabbits, change from grayish brown to snowy white, except for their ear-tips. So does the white-tailed jack rabbit. The northern weasels of both Hemispheres, even though they belong to several species, turn white in winter. In California the weasels that live in the mountains turn white, but those that live in the valley and near the coast remain brown. Although weasels are ferocious for their size, they are still small enough to be the prey of hawks and owls; they are almost as much in need of camouflage as the rabbits. The arctic fox, found from Greenland to Siberia, is grayish brown in summer, but when winter comes it changes into a white coat. The blue fox, which is only a color variety of this species, remains the same color all year around. Both varieties live in the same country, so the blue fox must have as much need of protective color as its changeable brother.

Other mammals change color less radically. Shrews in winter and summer coats may look like different animals; sometimes a brown species becomes quite blackish. The red squirrel is much redder in winter, and its ears develop tufts. Even in New York we see the gray squirrel looking ragged and moth-eaten. The new silvery fur makes the brownish summer coat look worn out, and bare spots often appear where the new hair has not grown in as fast as the old hair fell out. In spring, again, the winter coat will look just as worn.

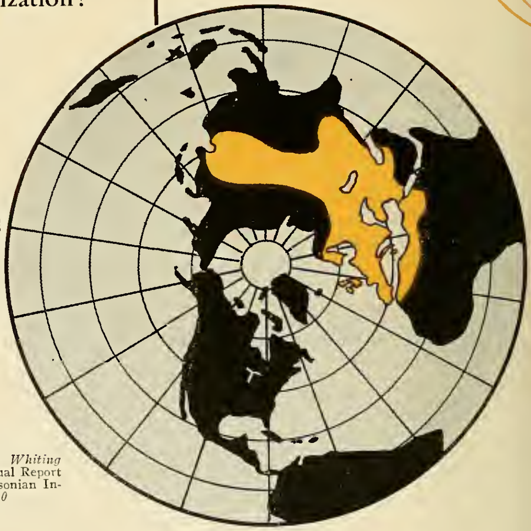
WHEAT

AND CIVILIZATION

By CLARK WISSLER
Curator Emeritus, Department of Anthropology,
American Museum of Natural History

After several hundred thousand years of primitive life, how did man suddenly discover all the basic inventions that underly our civilization?

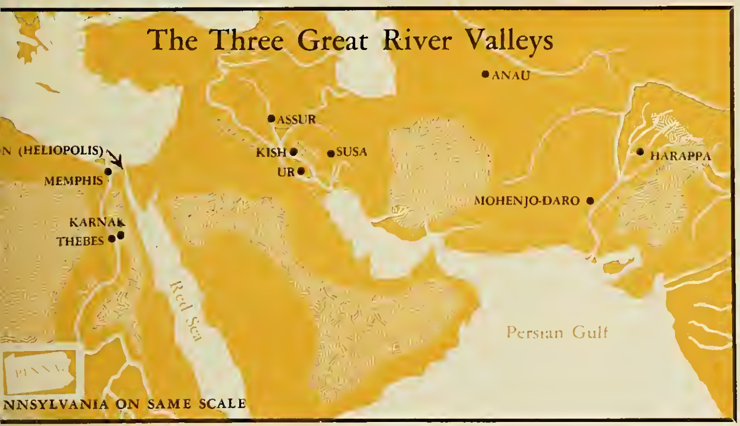
Rendition of early illustrations by
PAUL RICHARD



After Carl Whiting Bishop, Annual Report of the Smithsonian Institution, *1940*

▲ THE SPREAD OF WHEAT CULTIVATION is indicated by the following approximate dates: valley of the Nile 5000 B. C.; Euphrates and Indus, 4000 B. C.; China, 2500 B.C., and England 2000 B.C. Further, the use of the cart, plow, and bronze spread over about the same area between 3500 and 400 B. C. Since these are important traits in ancient civilization, we can say that the area for wheat is also the area of ancient civilization. Note again that China and England are marginal and that the elements of civilization reached them last, diffused from the ancient centers of Egypt, Sumer, and India

ARCHAEOLOGY tells us that civilization first emerged on the edges of three widely separated mud flats at the mouths of as many rivers, or around the deltas of the Nile, the Euphrates, and the Indus. Each of these rivers runs the main part of its course through an arid terrain, the world's greatest stretch of desert lands. Westward from the Nile lie 2,500 miles of the Sahara; eastward, between the Nile and the Red Sea is a long narrow desert; between the Red Sea and the Euphrates lies the great Arabian desert; between the Euphrates and the Indus lie the semiarid and desert lands of Iran and Baluchistan; immediately east of the Indus is the Indian desert. Though little rain ever falls on the lower courses of these three rivers, their upper branches traverse areas where heavy rains are periodical, causing annual floods in the deltas.



▼ EARLIEST CENTERS OF CIVILIZATION as defined by the ruined cities of On, Ur, and Mohenjo-Daro, the best known early sites. Further explorations after the war may lead to new discoveries and some changes in the picture

One would least expect to find the dawn of civilization in such a setting, yet on the edges of these deltas we find the ruins of pre-dynastic Egypt, of Sumer, and of ancient India. Here emerged the first planned cities the world ever knew, such as On (Heliopolis), Ur, and Mohenjo-Daro, all flourishing about 4000 B. C.

Until recently Egypt was believed the oldest and so the mother of civilization, but archaeological research in Sumer around the year 1926 revealed cities of a more advanced type than in the Egypt of 4000 B. C. Then a few years later cities on the Indus were uncovered which threaten to contest the lead of Sumer. Expert opinion, however, tends to concede a slight lead in priority to Sumer. Yet archaeology goes further in giving satisfactory proof that Sumer and her successors along the Euphrates passed on to Europe much of the "glory that was Greece" and so can justly claim to be the "mother of Euro-American civilization."

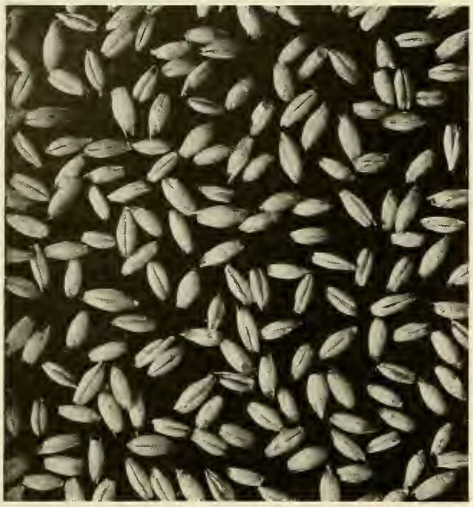
There is little reason to suspect that these three centers of civilization developed independently, since they are not only contemporaneous but when looked at closely their respective ways of living follow a common fundamental pattern. This pattern is characterized by cereals, domestic animals, the plow, the wheel, metals, writing, calendars, and cities. It is difficult to realize that these were then unique, novel traits of culture, appearing in the world for the first time. And what is more they are still the fundamentals of civilization.

Again archaeology tells us that man had existed for several hundred thousand years before civilization happened. In the meantime he had overrun the entire world, but his numbers were limited by the amounts of wild foods available and his ability to seize them.

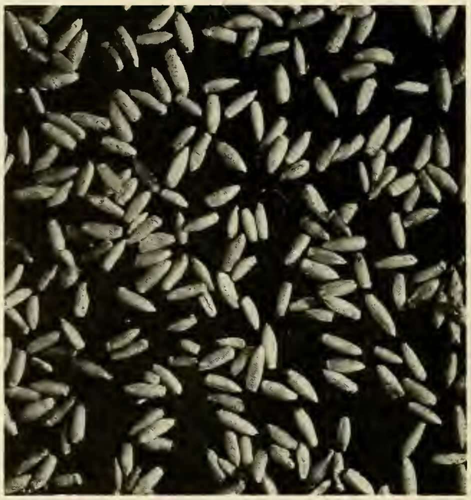
In contrast civilization arose some ten thousand years ago and was scarcely under way before 4000 B. C. What amazing changes has mankind experienced during these last 6000 years! But even more astonishing is it that between 7000 and 4000 B. C. were made all the basic inventions underlying our civilization. Nothing so revolutionary happened before or since.

The change in the way of living which set off this burst of inventive genius was the discovery of agriculture and the domestication of animals. We speak of this as revolutionary because it was a radical step. Throughout the long stretch of Old Stone Age time man simply gathered his food when and where nature made it available. For ages man was blind to his opportunities. Instead of pursuing and killing game animals, thus making them scarce and wild, he could have lived in friendly co-operation with them, protecting and conserving them, and living in luxury on their increase by the simple device of saving females and sacrificing the males. His native intelligence would soon reveal to him the principle of improvement by selective breeding. Within a generation or two he could have come into control of his animal food supply, instead of being dependent upon what nature offered him. All this seems so obvious to us that we are moved to lament the stupidity of man during 400,000 years of the Old Stone Age.

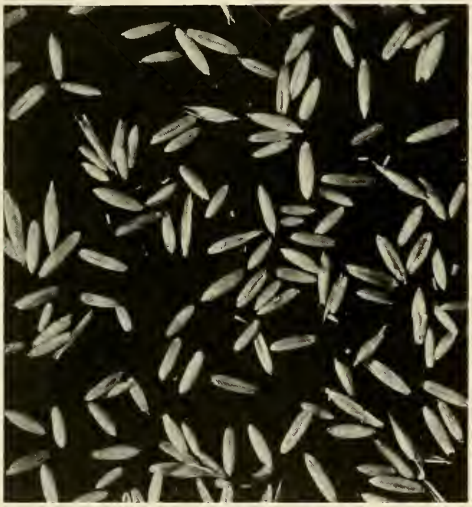
Yet the less obvious was to discover what could be done with the seeds of wild grasses. We now know that the most concentrated form in which nature supplies food is in seeds, but again it took man about 400,000 years to realize the significance of seeds—to see that in the application of his particular brand of intelligence to the exploitation of seeds lay the key to his future. We may never know just when and where some primitive genius first achieved insight as to how seeds could be multiplied and improved, but we do know that with the raising of wheat in the region of the three great river deltas the first civilizations emerged.



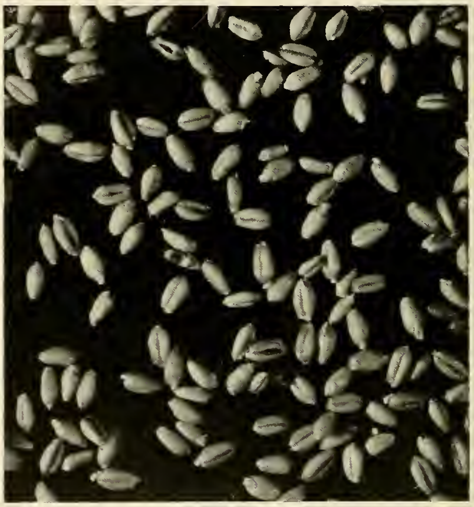
WHEAT



RYE



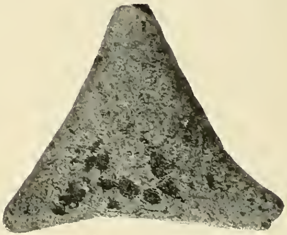
OATS



BARLEY

EARLIEST KNOWN BREAD

➤ At the ancient Egyptian site of Deir el Bahri the elements of civilization appear associated with wheat and barley. Strange as it may seem, some loaves of bread survived owing to the dry climate. A magnifying glass shows barley to have furnished at least part of the flour. Age estimated at 3500 to 4000 years



Courtesy of The Metropolitan Museum of Art

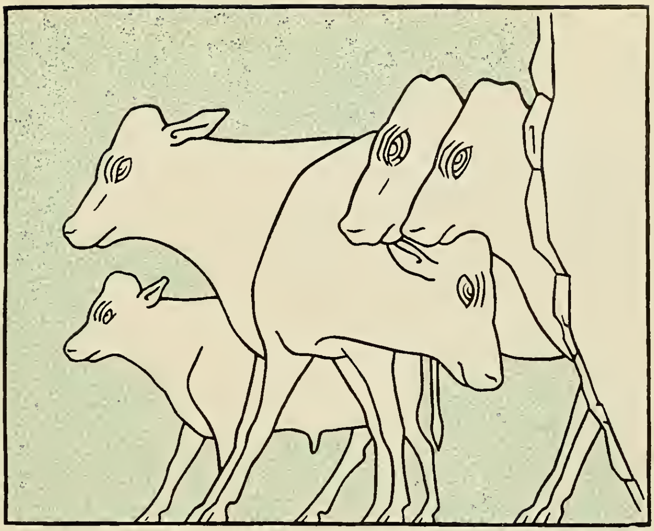
The Cereals

We gave the cereals first place in the fundamental characteristics of civilization because that is the verdict of history. The data from archaeology reveal that wheat, barley, and millet are the cereals which appear first. Later emerge rye, oats, and rice, all originally wild grasses. From the earliest known graves in the delta of Egypt come seeds of wheat and barley. In the delta of the Euphrates millet seems slightly earlier than wheat and barley; in the Indus valley, wheat appears with barley.

Everywhere wheat was preferred as it is still. It is abundant in yield, can be readily stored, preserved for a long time, and easily transported. Wild wheat (emmer) and barley survive in a few localities, ranging from Mount Hermon in Palestine eastward into central Iran both found growing together as man probably noticed them before he began to cultivate them. Wheat is superior for bread because of its high gluten content, so we may say that wheat bread is the basis of civilization, proof of which lies in its use as a symbol of life.

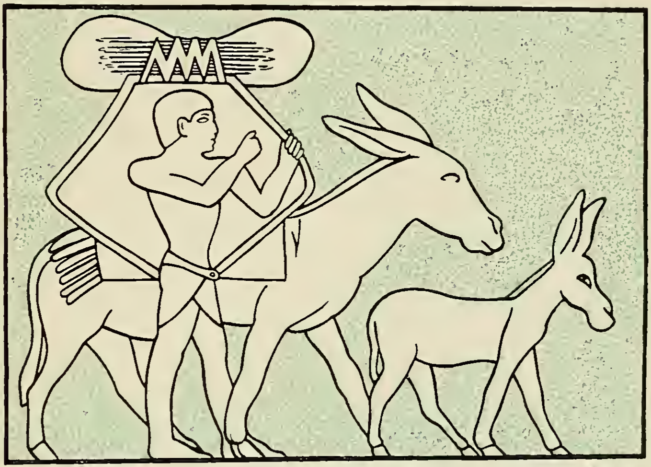
Domestic Animals

Not only are the ancient cereals still of vital importance, but the leading food animals—cattle, sheep, goats, and swine—are still the best. Their bones appear in the remains of these ancient first civilizations, and there is abundant evidence of their



After James Henry Breasted, The Scientific Monthly

▲ Skulls exist proving Egyptians bred both hornless and long-horned cattle, suggesting a long period of skillful breeding. 29th century B. C.

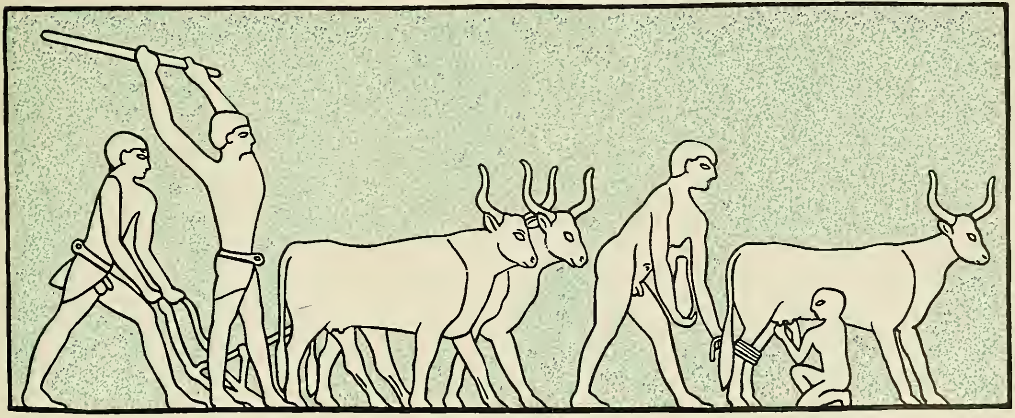


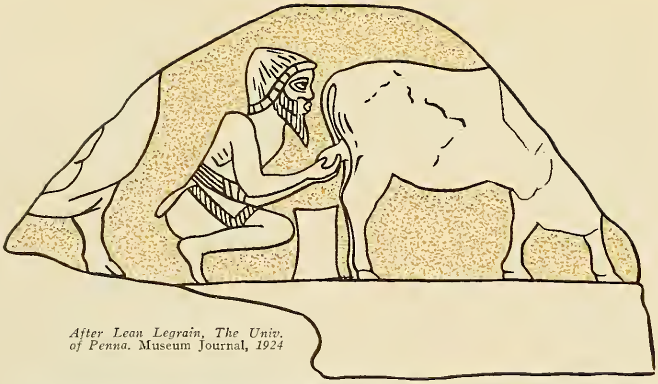
After James Henry Breasted, The Conquest of Civilization

▲ The donkey was the primary beast of burden and everywhere preceded the horse. Women and children rode it, men walked. Egyptian drawing, Pyramid Age

▼ Egyptians milked from the right side. Cow's legs were tied to protect the milker. 28th century B. C.

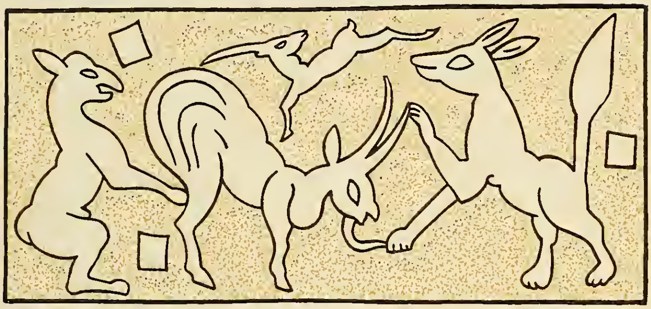
After V. Gorden Childe, Man Makes Himself





After Lean Legrain, The Univ. of Penna. Museum Journal, *1924*

▲ In Ur cows were milked from the rear, like goats, suggesting that the milking of goats may have preceded the milking of cows

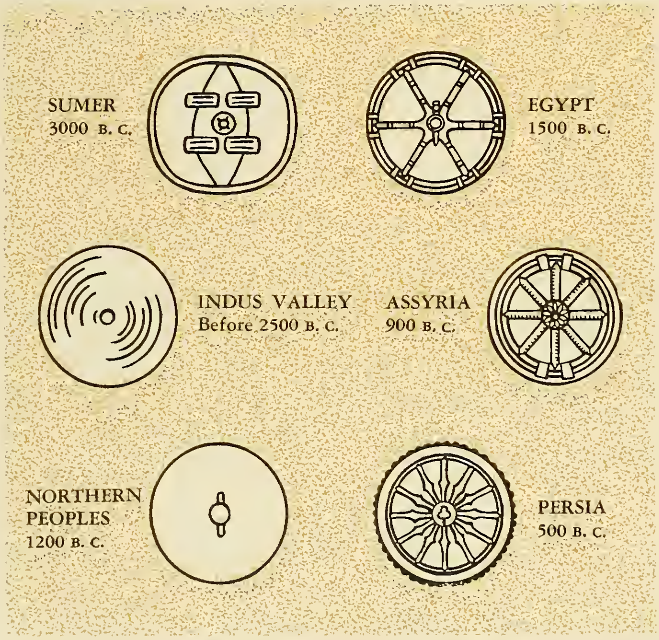


After Lean Legrain, The Univ. of Penna. Museum Journal, *1924*

▲ An ancient cartoon for a "bedtime story," showing foxes milking a goat, suggesting that people of the time milked goats from behind. We note further that the concept of the fox as a trickster is ancient, perhaps handed down from the Old Stone Age. The original drawing was found at Ur

▼ The place and time for the origin of the wheel are obscure. Its distribution over the ancient world closely followed the ox and the donkey

After James Henry Breasted, Ancient Times



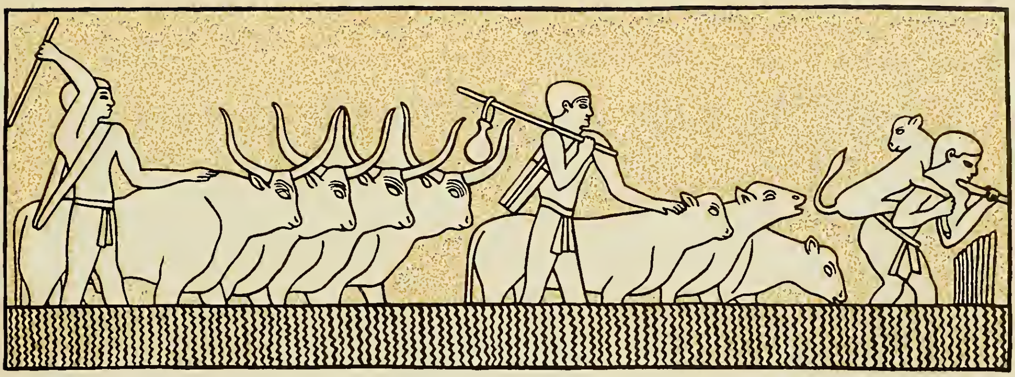
early domestication in surviving sculptures and frescoes on the walls of temples and tombs. Aside from the ox, the first draft animal to appear is the donkey; the horse appears some 1,000 years later, and the camel still later.

We find early sculptures and wall paintings showing the milking of cows in stables. Many such pictures found in Egypt appear modern in that the hind legs of the cow are tied to prevent her kicking the milker, and the calf is kept in front of the cow to check any tendency to "hold up her milk," a trick still used by our farmers. There are lifelike scenes of cattle being driven and led from pasture to stable. In one instance a man walks in front of the cow with her new-born calf on his shoulders, a sure way to induce her to follow.

The wild ancestors of cattle, sheep, goats, swine, and the donkey seem to have lived in and immediately around the three great centers in which these ancient civilizations emerged. Hunting scenes in which wild bulls, boars, and donkeys are pursued furnish evidence that the wild species were not immediately exterminated by domestication. We suppose it was an accident of nature that the wild ancestors of the best domesticated seed grains, food and draft animals evolved in the same part of the world.

The Wheel and the Cart

If you wish to evaluate the wheel as a trait of civilization, try to imagine what would be left if the principle of rotation were completely blotted out. Power-driven transportation would disappear. Away would go windmills, water wheels, steam and electric power. All goods must then be carried on the backs of men and animals, in rowboats or in small sailing vessels. Even hand- and foot-driven machinery would be eliminated. We cannot conceive of a worthwhile world entirely ignorant of the wheel. The earliest known wheeled vehicles appear in Sumer, four wheelers drawn by donkeys. A little later we meet with the chariot, or cart, first drawn by donkeys, then by horses. Ox-drawn carts, also, are shown in ancient drawings and sculpture.



After Breasted, The History of Egypt

▲ CATTLE CROSSING A CANAL. Two breeds of cattle appear in this scene, horned and hornless. Note the calf carried before its mother to lead the herd. The Egyptians took pride in their cattle, often showing herds on the march and in stables. The animals were used for draft, milk, and beef. The domestication of cattle may have preceded agriculture. In our alphabet, "A" is of ancient origin, derived from the picture of an ox head, inverted. Date of drawing about 3000 B. C.

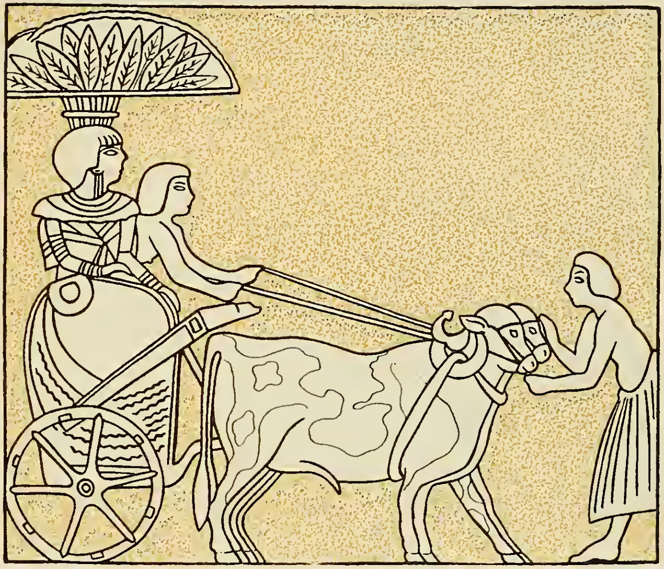
The Plow

The old theory was that the plow developed from the hoe, but now that we have more data on the early forms of the plow, it is clear that it evolved from the digging stick, a stick pushed into the ground to break up the soil. Possibly the first plow was drawn by men as shown in an Egyptian wall picture, but in other Egyptian drawings oxen and even donkeys are yoked to the plow. In one of the Egyptian drawings the grain seems to be thrown so that the plow will cover it, but a sketch on a seal from Babylon goes a step further in showing a seeding machine, the seed being dropped into a funnel which discharges it behind the point of the plow. This is a near parallel to a modern type of machine for sowing wheat.

These ancient plows seem crude and simple, yet the type survived until recent times. Around 1550 the Spanish introduced the plow and oxen into Mexico and thence to the Indians. As late as 1900 Pima and Papago Indians were using crude wooden plows in Arizona and northern Mexico, examples of which are in the collections of the American Museum of Natural History. Some of these were provided with stone points, indicating that the stone age still lingered here. The plow of today, the modern mould-board plow, was invented by Thomas Jefferson, about 1800.

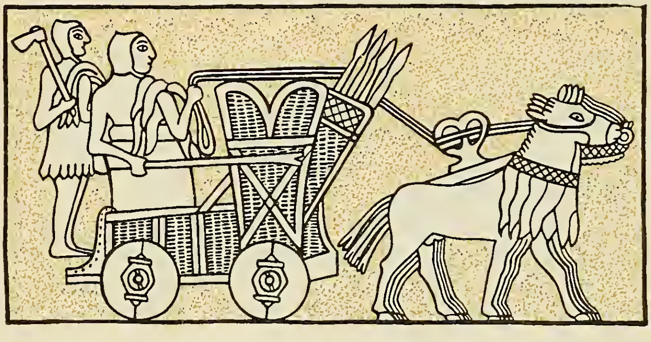
▼ THE OX was sometimes used with a chariot in Egypt, as shown by this wall picture. The passenger is appropriately a woman. The men drove horses

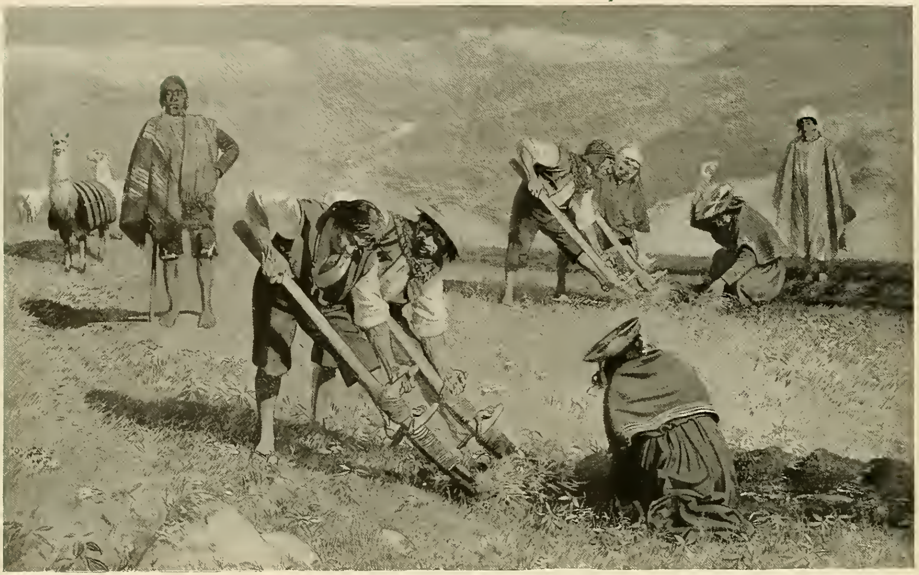
Courtesy of The Metropolitan Museum of Art



▼ THE EARLIEST portrayed war chariot had four wheels and was drawn by donkeys. Sumer, about 3000 B. C.

Courtesy of The Library of Science and Culture

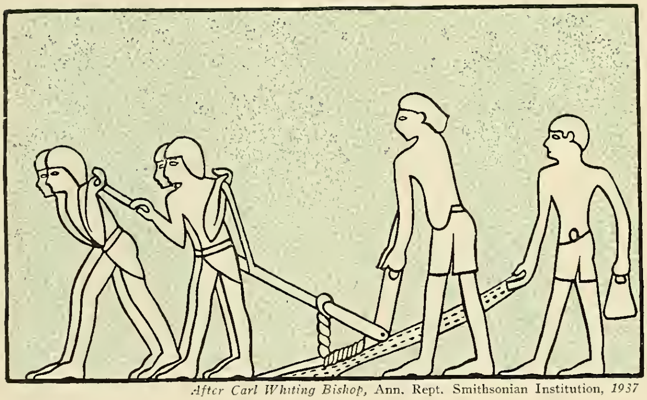




Courtesy of the Chicago Natural History Museum

PERUVIANS PLANTING POTATOES

▲ THE ABORIGINAL FOOT-PLOW was an improved digging stick used to turn sod and hard ground. Simple forms of the foot or digging-stick plow were used in western Europe within the last century

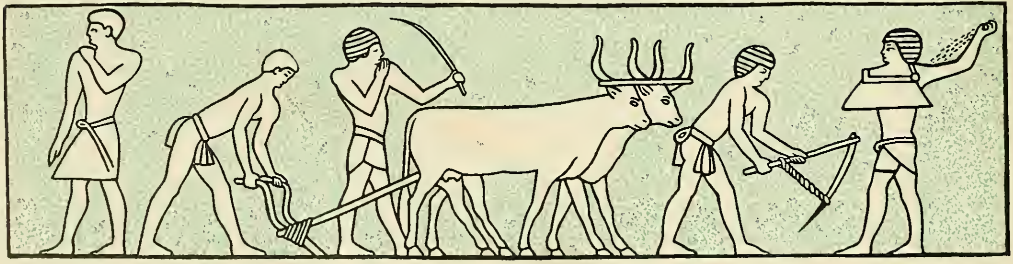


After Carl Whiting Bishop, Ann. Rept. Smithsonian Institution, *1937*

◄ AN EGYPTIAN man-drawn plow. Grain is sown by casting into the furrow. 18th Dynasty, about 1400 B. C.

▼ EGYPTIAN PLOW drawn by cows. Note the two handles. It has been proposed that the Egyptian hoe, as shown at right, was the original form of the plow. But the simple digging stick and its successor the foot-plow are now considered the probable parental forms

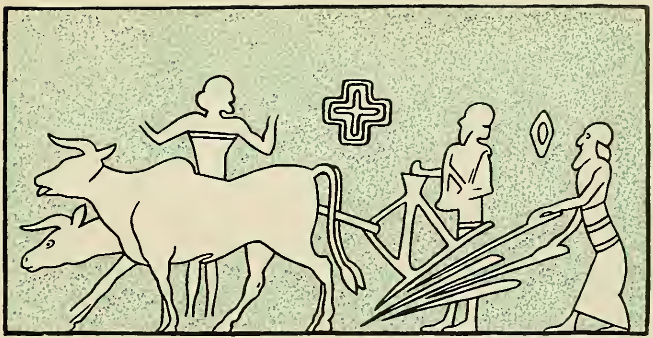
After James Henry Breasted, The History of Egypt



No doubt the sowing of grain preceded the invention of the plow. The Egyptians sometimes sowed wheat and barley on the mud flats of the Nile after the annual floods receded, and drove flocks of sheep and cattle over the soft ground to tread the seed into the soil, not merely to plant it but to protect it from birds. It is possible that sowing wheat began in the deltas by merely scattering the grain after the waters receded. Farming would thus be simple, since each year nature would spread a fresh layer of fine soil over the fields.

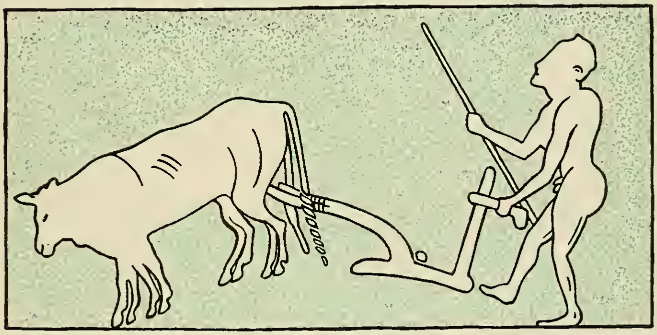
Inventions in the Long Pre-Civilization Period

We should not overlook the important fact that man was a speaking, thinking inventor for several hundred thousand years before the relatively recent civilization boom. Fire was probably his first great invention. Inventing a handle for the stone axe was another great step. Twisting string was another. Then the inventions of art—line drawing, sculpture, clay modeling, color painting, perspective, and composition—all appear before civilization. The invention of needles in Solutrean time tells of another great step. Again the burial of the dead with mortuary offerings proves that early man was by no means slow in constructing a religious philosophy. The chart we give for outstanding inventions during the Stone Age speaks for itself. It reveals part of the preparation man had made for the rapid, astonishing speed of achievement in civilization when the release came.



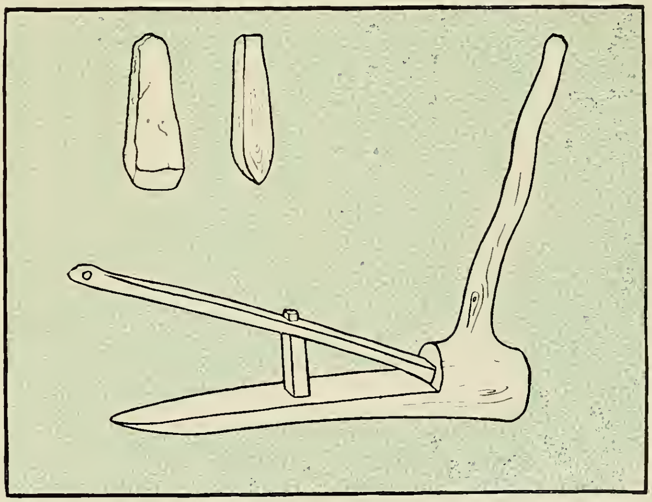
Courtesy of the Univ. of Penna. Museum Journal, *1910*

▲ Earliest known mechanical seeder. An ancient seal from the Euphrates country shows this plow equipped with a hopper to receive and sow the seed

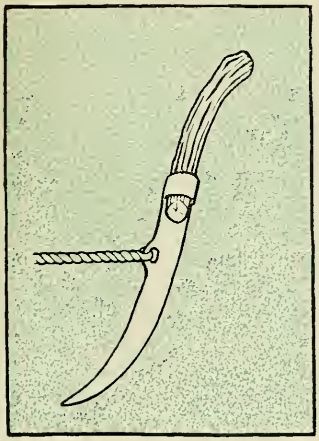


After Carl Whiting Bishop, Ann. Rept. Smithsonian Institution, *1937*

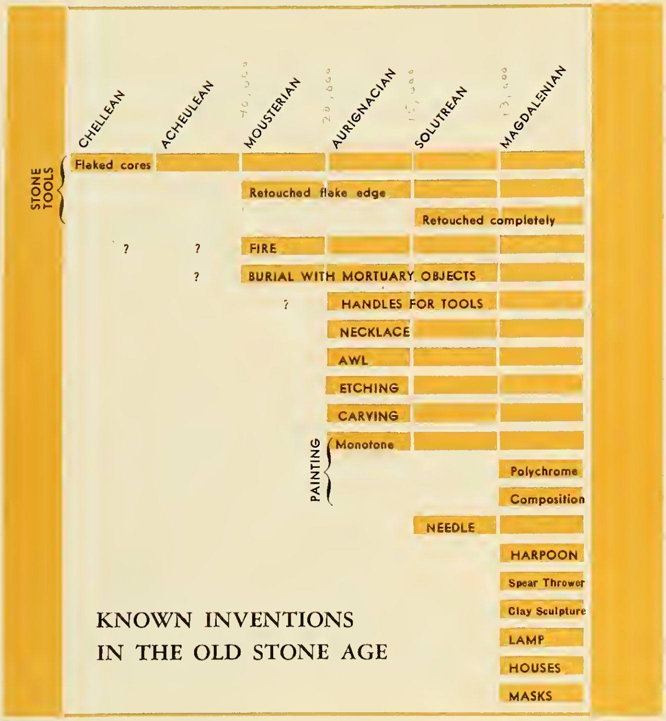
▲ Early Greek plow, from a vase painting. All these ancient plows used cattle, not horses. The horse appears relatively late in ancient civilization and was at first valued for its speed and use in war



▲ A survival of the primitive plow is found among the Indians in Arizona and Mexico. As late as 1850, some of these plows were used with detachable wooden or even stone points



◀ Japanese ceremonial plow in the form of a digging stick with an iron blade, drawn by man-power. From a drawing by the author; specimen in the museum of Tokyo



KNOWN INVENTIONS IN THE OLD STONE AGE

experience with animals, he knew how to fight off the lions and other carnivores to protect the peacefully inclined ruminants. Nature herself gave yearly demonstrations of planting crops of grasses and of irrigating the marginal dry lands. So man could begin to co-operate with the herbivorous animals and to exploit plants. Because of increasing food supply, his own numbers increased geometrically, cities arose, herds multiplied, and cereals improved.

The many pictures of kings killing lions, wild cattle, etc., may not be just sport but symbolic of man's war against the wild animals from without that menaced the increase of his tame herds and threatened his growing crops. Also there were envious nomadic hunters on the outskirts, learning to be farmers and herders by imitation, ready to raid and dispossess the civilized of their rich lands, herds, and cities. New blood and abilities were ready to displace the old to carry on to greater achievements.

Most of this is speculation, but whatever the causes, it did happen. Once man sensed that he could by self-discipline produce more and more food and comfort, a few centuries would suffice to rear mighty cities and great civilizations. Significant changes in the ways of living would follow within a single generation.

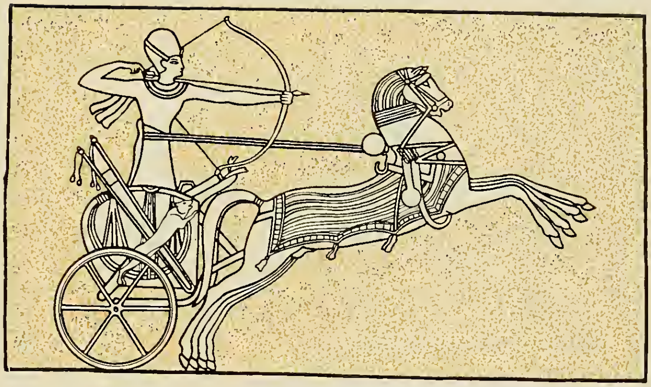
Yet at the outset the ages-old nomadic hunters might need something more than the shock of a strange environment to break old habits; at least nature was kind enough to offer yearly demonstrations in sowing and irrigating. We shall never know, but the facts we have hastily reviewed offer some hints as to how it may have been that civilization arose around these river deltas as revolutions in living. The explanation may lie in the commonplace circumstance that for part of the year man could graze his herds upon the dry lands marginal to the rivers, while producing enough grain and hay along the borders of the river to stable-feed the animals when pastures failed seasonally. What we call civilization may be little more than wise integration of farming and animal husbandry.

As a nomadic hunter man could never grow numerically strong. Even with the best possible social organization, camps of hunters must be small and scattered. Critical studies of living conditions among surviving savages gives no ground for believing that the population of the world under a purely hunting and gathering economy could have been large. The approximate land area of the world is 50,000,000 square miles; the estimated land needed per capita to support a hunting population is seven to ten square miles. Then in round numbers the expected primitive populaion of the world in 7000 B. C. would not exceed 7,000,000—about the population of New York City.

Yet we know that cities of moderate size accompanied the rise of civilization and that achievements of civilization would have been impossible without local concentration of thousands of adult human beings.

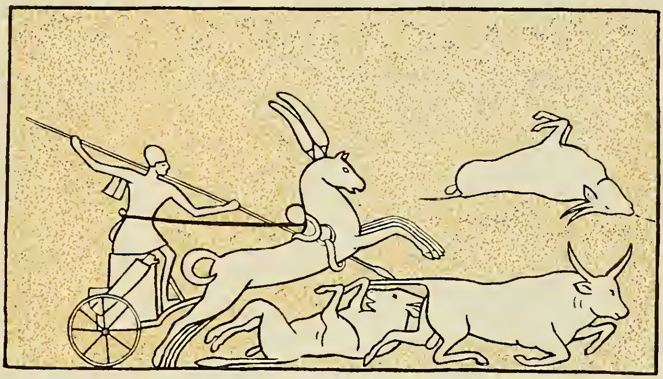
A Possible Explanation

The reader may still be perplexed as to why it was just here in these deltas and narrow river valleys in the midst of deserts that civilization happened. The answer may be that these were the most favorable places. As local environments they were very much alike. What we do know is that these rivers flooded regularly once a year, that the people found it easy to grow cereals there, that cattle, donkeys, swine, sheep, and goats were in the country. We expect these animals would crowd into the fine feeding grounds of the deltas at least at the times of the year when the pasture on the arid uplands was thinnest. When man was forced to seek refuge in the same place, he found the animals in possession. Wild animals, wild plants, wild men, all predatorily inclined, crowded into the same narrow river valleys, and, not unlike flood victims on a raft, were forced by necessity to adopt a more economical use of space. Man's type of behavior was best able to cope with this new situation. He may never have faced the like of it before, but if so, he had failed. As a hunter with several hundred thousand years of



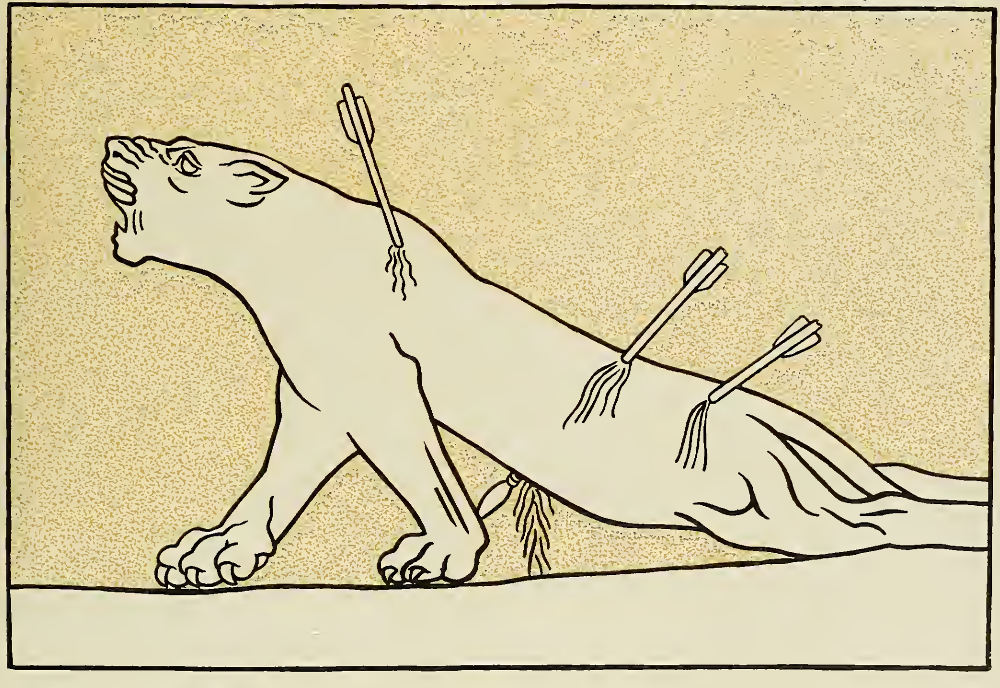
➤ EGYPTIAN WAR CHARIOT. Well trained horses were guided chiefly by words, but usually by a separate driver. The chariot spread to Europe and was used effectively by the ancient Britons in wars against the Romans

After James Henry Breasted, Ancient Times



↘ THE EGYPTIAN King Ramses III, hunting wild oxen in the delta marshes of the Nile. In the Euphrates country, hunters speared lions from chariots and sometimes from horseback

After James Henry Breasted, A History of Egypt



↓ ONE OF THE FINEST sculptures in low relief depicts a wounded lion struck by arrows and paralyzed by a punctured spine. Ancient peoples hunted probably not just for sport but to protect their herds

After James Henry Breasted, The Conquest of Civilization

RUBBER

By HAROLD N. MOLDENKE*

Loss of nine-tenths of the world's rubber sources to Japan opens a new chapter in the story of one of Nature's most important contributions to modern life

ONE of the greatest mass migrations of people in recent times is now under way in the vast Amazon basin of tropical South America. This basin is larger than the United States, and into it are pouring thousands of laborers and their families from other sections of Brazil, Bolivia, Peru, Ecuador, Venezuela, and Colombia. Whole districts of Santa Cruz province, in Bolivia, are being depopulated by the trek into the Amazon area. By the end of this year it is estimated that some 100,000 workers and their families will have moved into Amazonas.

The reason for this mighty movement of humanity is *rubber*. Once before in history there was a great rubber boom, and the 273-year-old town of Manaos, 1000 miles up the Amazon River, became the center of a major industry. Manaos lies on the black waters of the Río Negro just above where they join the Amazon. Now it is again teeming with life and humming with activity. Once again its ten-million-dollar opera house, the Teatro Amazonas, may seem more than the relic of a shattered dream.

After months of tire and gasoline rationing and bans on pleasure driving, the American public probably does not need to be reminded how strategic rubber is in our war effort. All the world except Japan is today gasping for rubber. In 1941 the United States imported over a million tons of it. This year we need 600,000 more tons. Airplane tires, for instance, require 33 to 100 pounds of rubber each; a supply truck uses 100 to 500 pounds; a medium-size tank 1700 pounds. The bulletproof gas tanks of big bombers take 1250 pounds. A battleship uses 75 tons—the equivalent of 17,000 automobile tires. It is essential in gun carriages, pontoon bridges, antiaircraft guns, barrage balloons, scout cars, and pneumatic rafts, to mention only a few military uses.

The sources of rubber are many. Hundreds of plants are known to produce latex. The late Thomas A. Edison analyzed thousands of American plants for rubber potentialities. A dozen or so have proved commercially practicable under certain conditions. Some of these will be discussed in the next article in this series.

Most important of all the sources of rubber is the Pará rubber tree (*Hevea brasiliensis*), a member of the spurge family and native to the Amazon basin. Here there are estimated to be some 300,000,000 wild trees, which could produce 50,000 tons of this "black gold" annually. In addition, 10,000,000 choice seeds and

Burton Holmes from Ewing Galloway, N. Y.

▲ A TYPICAL PEACETIME SCENE in a rubber plantation in the Straits Settlements

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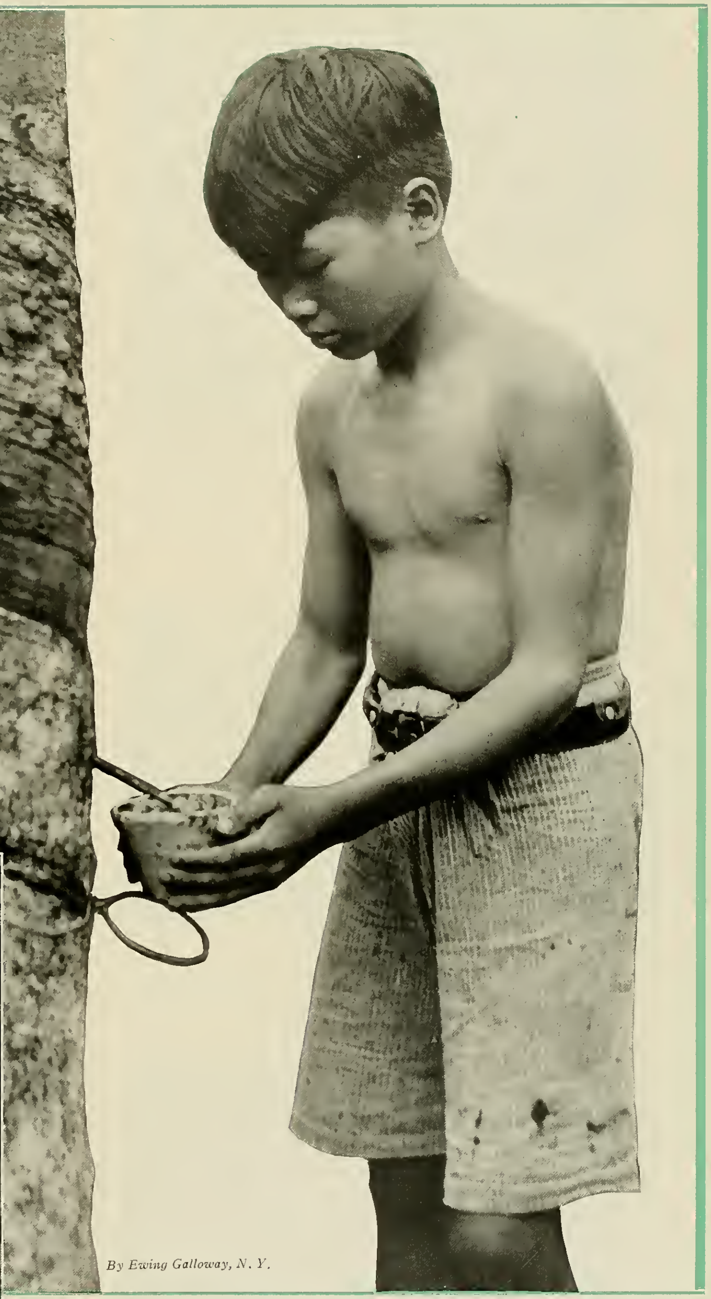
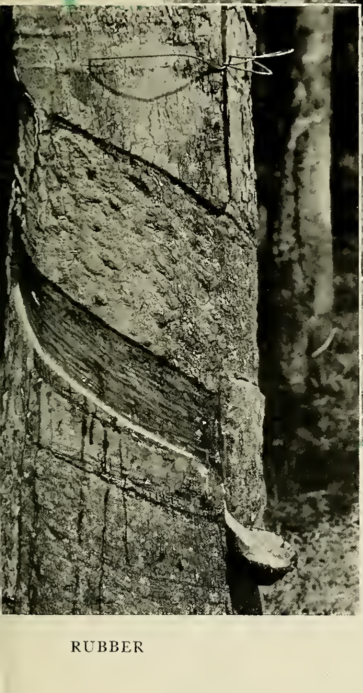
*Dr. HAROLD N. MOLDENKE early distinguished himself in botanical circles at Susquehanna University, from which he graduated in 1929. Advanced studies led him to the degree of Doctor of Philosophy at Columbia University. Most of his professional life has been spent with the New York Botanical Garden, where he was advanced to an associate curatorship in 1937. In 1935 and 1936 he traveled to England as a National Research Fellow, carried on special studies at the Royal Botanic Gardens and the British Museum of Natural History, and visited the chief botanical institutions in 13 European countries. He is a member of various scientific societies and is especially expert in the phases of botany that deal with the classifying and naming of plants. He has collected plants in 47 states and 16 foreign countries.

In appreciation of advice generously given him in connection with this and the next article in the Strategic Plant Series, Doctor Moldenke expresses his gratitude to Messrs. G. L. Wittrock and J. Monachino, New York Botanical Garden; Misses Dorothy Richtberg and Alexandra Kalmykow; the releases of the Office of the Co-ordinator of Inter-American Affairs; and the periodicals *Science News Letter* and *Agriculture in the Americas*.

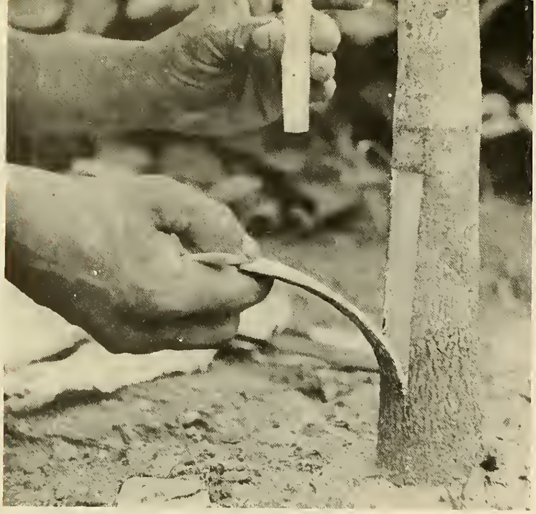


By Ewing Galloway, N. Y.

▲ Lifeblood of progress along man's rough road: a young Malay boy gathering latex, the elastic sap that smooths the way for a civilization on wheels



◀ A panel-like cut is made in the bark of the tree, severing the latex vessels, which are in the innermost part of the bark. Above the fresh cut an old tapping scar is seen in this photograph. The bark renews itself in six or seven years

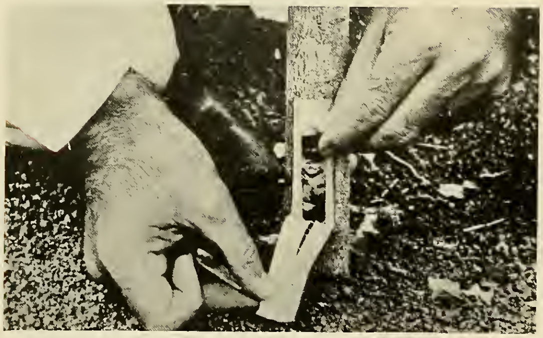


Severin from Three Lions

▲ Trees that will mature faster and yield more rubber are produced by a delicate grafting operation. A flap of bark is carefully cut away near the base of the sapling

▼ The bud tissue from a high yielding tree is inserted, and the bark is pressed back over it

Boury from Three Lions



▼ Finally the bark covering the bud is spirally bandaged with paraffin tape, which is removed after a period of from 18 to 35 days. Growth of the bud provides vigorous sap production on the already established root system

Severin from Three Lions

1,500,000 seedlings are supposed to have been brought out of the Far East before invasion by the Japanese, and 25,000,000 seeds are being planted in twelve tropical American countries. More than 100 cooperative nurseries have been established in fifteen countries, and nearly 30,000,000 budded rubber trees have already been produced.

Scientific research and guidance are being provided by five agricultural experiment stations strategically located in the rubber-producing areas. Agreements for the purchase of rubber from various wild sources have been made between the United States and the rubber-producing countries south of the Rio Grande. Large funds have been made available and are being spent in the expansion of rubber production and for health and sanitation projects to protect the workers. The rubber tappers, working deep in the heart of the jungle, are able to live "off the country" to a large extent. Dairy and farm projects are being organized in the area in order to make them completely self-sufficient. In one of the largest public health programs on record, swamps have been drained, malaria controls set up, and sewage facilities and water supplies improved as staffs of trained personnel and technicians are moved to strategic places. Half a dozen large hospitals are being built, and at least 50 dispensaries are reported to have been provided to give medical services. Many of these are on motor launches, which can cruise along the Amazon and its many tributaries to reach places inaccessible by land. All rubber workers in Brazil have been exempted from military service. Intensive government-sponsored advertising programs are appealing for more workers, who are assembled in recruiting stations. A chain of twelve rest stations is being built across northern Brazil along the route of the workers trekking into the Amazon basin through the gateway of Bélem. Here they are provided with shelter, food, water, clothing, and medical supplies. Army transport planes and bombers have flown *Hevea* seeds and seedlings from nurseries to new plantation sites in the long range cultivation program. Tappers and supplies have in some cases been dropped by parachute. An aerial cargo transport system has been set up to speed the delivery of equipment, supplies, medicine, and personnel to inaccessible parts of the Amazon basin and to bring out rubber and deliver it to concentration centers where it can be picked up by river steamers.

These are some of the exciting facts which give evidence of how important this rubber production program is regarded by the governments of the United Nations, and why the "Battle of Rubber" being waged in Brazil and elsewhere has been called probably the "biggest story in South America" today.

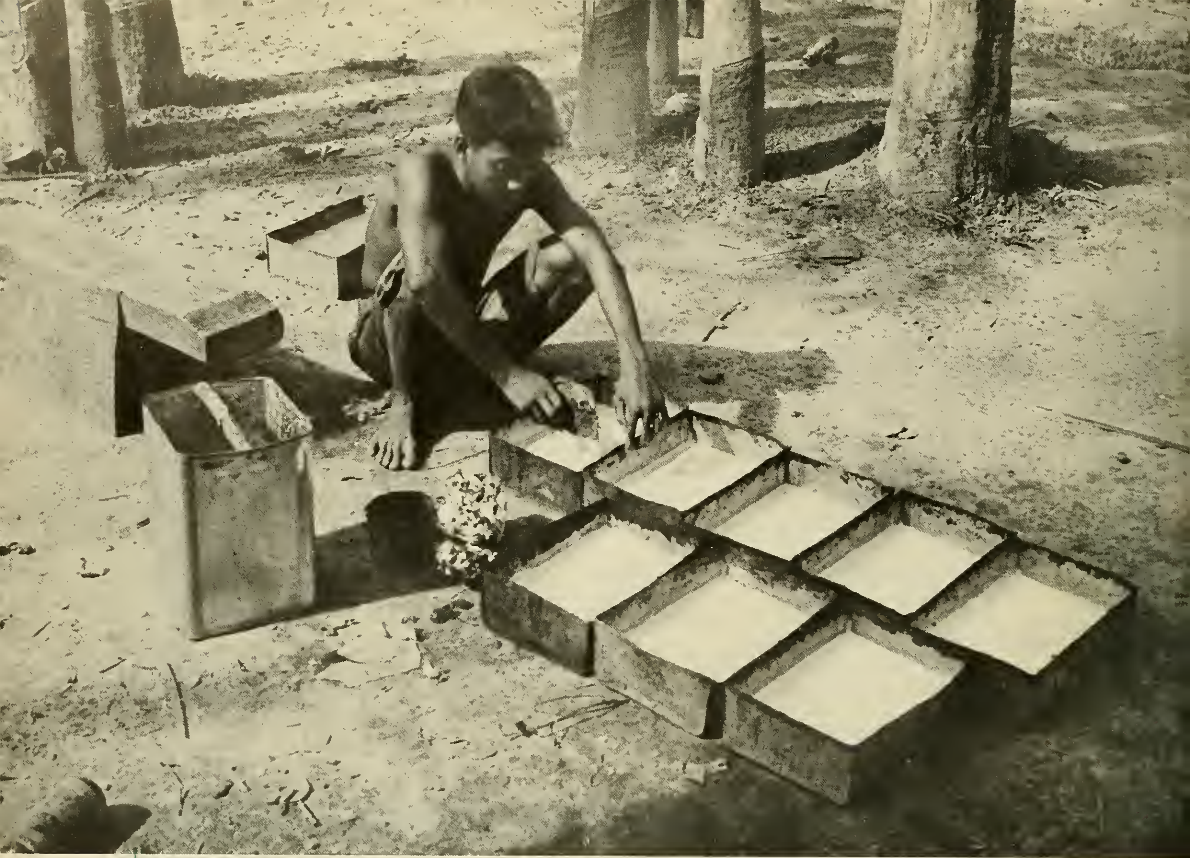
The rubber industry in Brazil has been dormant since the shift to the East Indies some 30 years ago of 90 percent of the world's annual rubber production. During the intervening years the rubber gatherers had scattered widely. Unused native trails, 3000 miles from the mouth of the Amazon had disappeared. Machete-scarred rubber trees, scattered thinly over an area as large as continental United States, had again been swallowed up by the jungle. Not only in the Amazon region, but also in the Orinoco valley, in Mexico, in Haiti, and in many other of the Western Hemisphere countries a frenzied search is now being made for native or introduced rubber trees, once prized for their latex, then neglected, now looming again as one of the most valuable assets of the hemisphere.

Henry Ford's new rubber plantation at Belterra, Brazil, is located within a few miles of the spot where in 1876 Henry A. Wickham unwittingly struck his devastating blow to the American rubber industry by obtaining 70,000 seeds of the *Hevea* tree and smuggling them out of the country to England. These seeds became the ancestors of nearly all of the 8,000,000 acres of *Hevea* rubber trees in the East Indies and Malaya, from which the United States obtained 93 percent of its rubber supplies in recent years. Now, with the Asiatic rubber-producing areas in the hands of the Japanese, the industry comes back again to its original home.

The operation known as tapping, by which the latex is obtained from a rubber tree, is in reality a form of bleeding. A downward 30-degree panel-like incision is made in the bark of the tree, sufficiently deep to sever the latex vessels which are in the innermost portion of the bark. Tapping begins when the tree has a circumference of about eighteen inches three feet above the ground, a girth it usually attains in six or seven years. The tapping cut usually extends half way around the tree, and its upper end is always to the left as the tapper faces the tree. Shallow vertical grooves are made at both ends of the cut—on the upper end to indicate where tapping is to begin and on the lower end to provide a channel down which the latex can run by way of a spout into a collecting cup. When tapping begins on a new panel, several cuts are made to remove the bark gradually before the latex-bearing cells are reached. Thereafter only one cut is made at each tapping, and tapping is done on alternate days. On each tapping day after the first a thin shaving of bark is taken from the lower edge of the previous tapping cut. Thus the bark is gradually removed as the position of the tapping cut moves slowly down the panel. The thickness of the shaving removed each time is about a

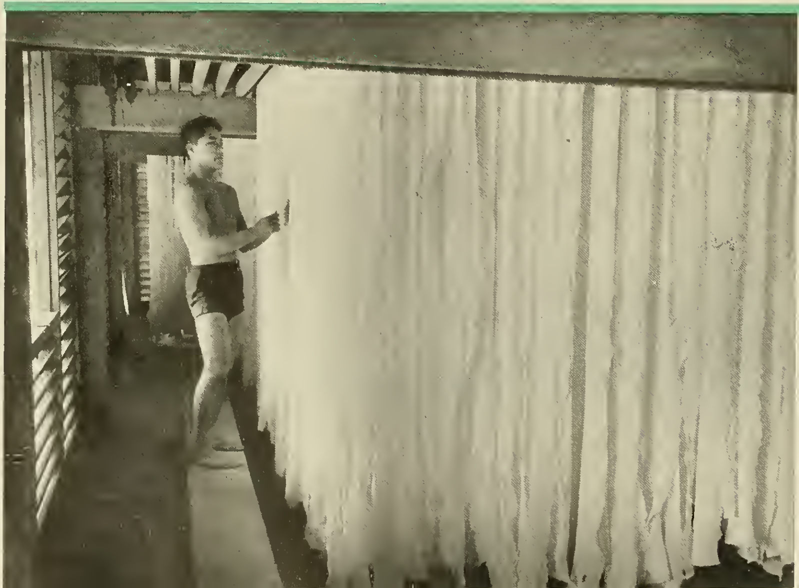
Burton Holmes from Ewing Galloway

▲ THE "BUCKET BRIGADE" wades the Rewa River in Fiji, carrying latex from the plantation



Screen Traveler, from Gendreau

▲ THE STUFF from which rubber is made leaves the tree as a milky fluid. A scene from Sumatra, near the pre-war center of the world's rubber supply. The ancestors of most of the rubber trees throughout the East Indies grew in America. A devastating blow to American rubber industry was unwittingly struck in 1876 when 70,000 seeds were smuggled out of Brazil



➤ A MACHINE resembling a clothes wringer is used to press the congealed latex into sheets, near Moeratembesi in Sumatra

Philip D. Gendreau, N. Y.

◂ SHEET RUBBER in a drying shed at Singapore, the crude rubber capital in pre-war days

By Ewing Galloway, N. Y.

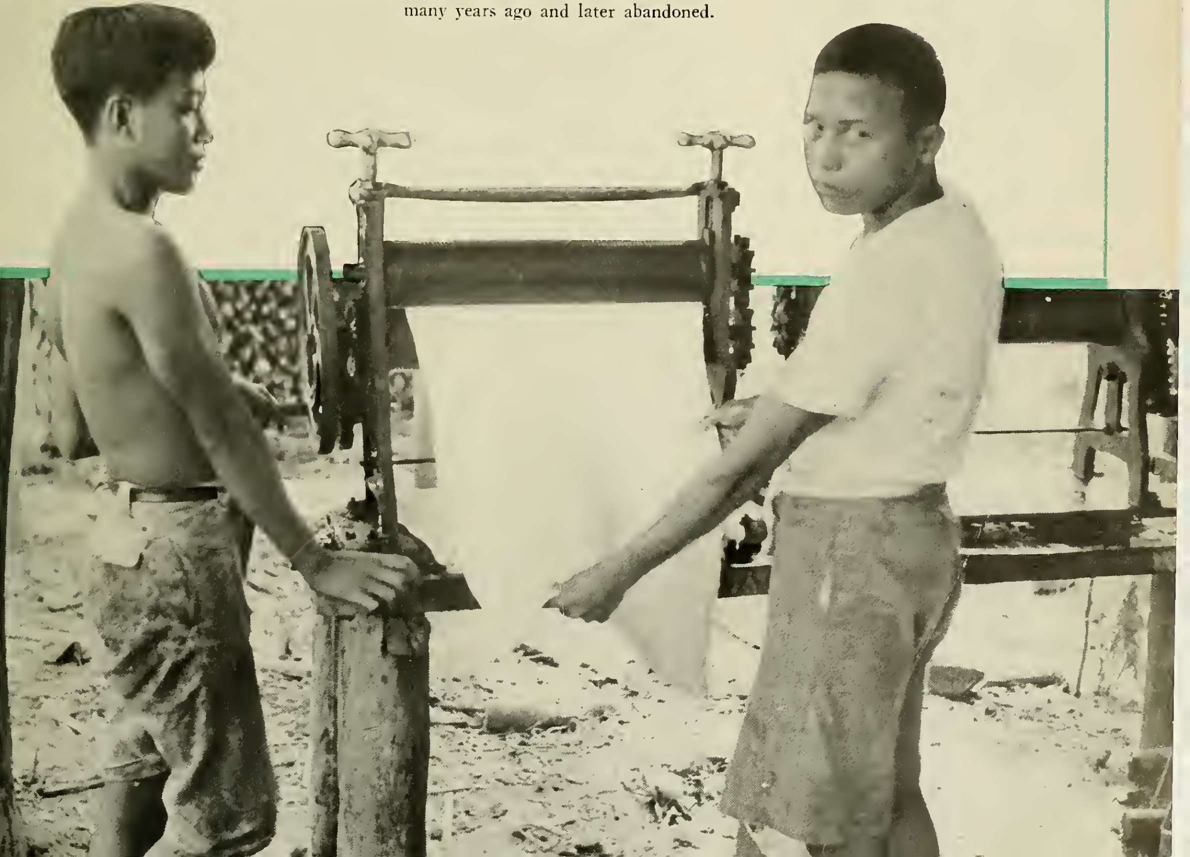
thirteenth of an inch, and a careful worker, tapping every other day, will move downward over the surface at a rate of about an inch a month. If tapping is so deep that the wood is exposed, wounds will result and it will be difficult (if not impossible) to retap the same panel. In about three years the tapper will have progressed down one side of the tree to near the ground level, and then he begins on the opposite side of the tree. Thus, 6 or 7 years are allowed for the tapped bark to be renewed before tapping is repeated on any given side or panel.

In 1940 and 1941 about 15,000,000 rubber trees were planted in Latin America. So important was the transportation of rubber tree seeds and seedlings that the Army furnished bombers to carry them from Liberia and Brazil to various distribution centers.

Second in importance in the rubber industry is the Central American rubber tree (*Castilla elastica*), belonging to the mulberry family and native only to southern Mexico. Some 9 other species of the genus, however, extend from Mexico to Bolivia, Brazil, and Peru. Common names in Central America and Mexico are *hule* and *caucho*. Wild *Castilla* trees are found in open forests and on the margins of dense jungles. The largest trees attain a height of 150 feet and a trunk diameter of five feet. The trunks have buttressed roots when old and rather smooth, thick, light gray-green bark. Trees can be tapped two or three times a year without serious injury and with a fairly good yield each time. Trees under ten years of age give very inferior yields, and 20 years must elapse before tapping becomes really practical. Early tappers in the Amazon area used to cut down the giant trees and obtain up to 50 pounds of rubber per tree. This practice accounts for the relative scarcity of large trees today. The value of *Castilla* at the present time lies not so much in new slow-maturing plantations, but in wild trees and in plantations established many years ago and later abandoned.

In Ecuador about 2,000,000 *Castilla* trees were planted before the First World War but were neglected after lower-cost plantations in Malaya and Java flooded the American and world markets. Rubber from these trees once sold for as high as $3 a pound, but the price dropped to two and one-half cents a pound in the world collapse of commodity prices from 1929 to 1932. Two species, *C. elastica* and *C. panamensis,* are being cultivated in Haiti. In Ecuador's Oriente region rubber is harvested from a wild species of *Castilla* by the Yumbo Indians. These natives have no need of money but will tap the trees for colored beads and such useful domestic articles as cloth, thread, needles, fishing-lines, scissors, salt, machetes, rifles, cartridges, etc. Beads, once quoted at eight cents a pound, now bring $17 a pound at Quito, the usual payment being four pounds of beads for 100 pounds of latex.

Experts state that Panama has more



By Ewing Galloway, N. Y.

➤ A **PRIMITIVE CART** rattles wearily toward the waterfront of Singapore, carrying the stuff that permits an automobile to travel 60 miles an hour as though on air

➤ **TREASURES OF THE EAST:** rubber and tin ready for export from Penang, Straits Settlements, now in Japanese hands

Castilla trees in proportion to its size than any other Caribbean area. As in the case of South American forests, the problem of getting out this rubber is one of manpower and transportation. The average *Castilla* tree yields from 1 to 3 pounds of latex at each tapping. By cutting down the tree more rubber can be obtained at one time, but the productivity of that tree is naturally ended. The Canal Zone is now supplying "scrap rubber," which is the hardened milky juice that collects at the base of the *Castilla* trees after they have been tapped in herringbone fashion—a lower grade of rubber than the smoke-cured sheets prepared from more carefully collected latex.

Before the turn of the century *Castilla elastica* was one of the three trees that were close rivals in the production of the rubber, fast becoming important as a commodity of commerce. In some countries it was the favorite; in others the Pará rubber tree took precedence; while in Java the Assam rubber tree (*Ficus elastica*) was most popular. Environmental conditions which seemed to be the most suitable for one species in a given country were not satisfactory for another, and so different species were chosen for cultivation. Plantation practices varied greatly, and many different methods of extracting the rubber were employed. Then, in 1897, a new method of tapping *Hevea* trees was discovered. This method enabled harvesters to tap the trees without injury at intervals of one, two, or three days throughout the season, instead of only a few times as had been done before. This is essentially the method still employed today and results in an annual yield from a *Hevea* tree far exceeding that from either of the other trees, which can be tapped only a few times each season without serious damage to the tree. Physiological and anatomical differences in the bark prevent the same method being employed on the other trees.

In Mexico and Central America the *Castilla* tree was always the most popular. Its latex had provided the natives with rubber before Europeans first set foot on American soil. Indians of Mexico made large rubber balls for playing a game like basketball, in which rings were used as goals, set high on the walls of a specially constructed court. They also used rubber for waterproofing and to tip drumsticks. In 1872 about 100,000 trees were planted in Chiapas alone, and by 1910 Mexico had 135,000 acres of *Castilla* plantations and exported over 8000 tons of rubber. About this time, however, production of *Hevea* rubber was increasing tremendously in the Far East, where labor costs were lower and yields higher. The price of rubber consequently dropped. Mexican and other American plantations were gradually abandoned, and since 1928 less than one ton of *Castilla* rubber has been exported from Mexico annually. The same story was repeated in other Latin American countries. Now fabulous sums are being spent in seeking out *Castilla* and *Hevea* trees, and veritable armies of men are engaged in harvesting the precious latex, growing seedlings, breeding disease-resistant, high-yielding types, setting out more plantations, and

➤ DOCK COOLIES handling crude rubber at a Singapore wharf

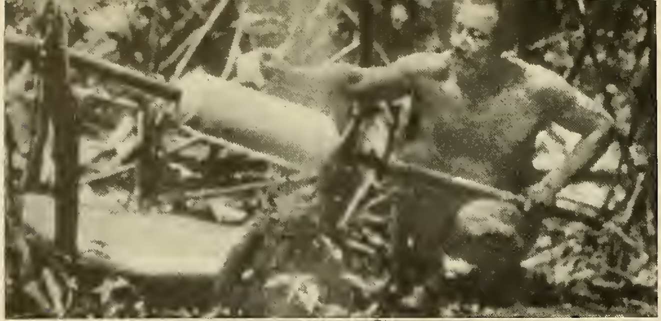
By Ewing Galloway, N. Y.

▼ SOME never reached port: negroes salvaging a bale of crude rubber washed ashore from a torpedoed ship along the Florida coast. So dire had the rubber shortage become, these men were paid about $75 for their hour's work

Photo by Gilbert L. Campbell

improving the methods of processing this "black gold"—exciting and strategic prize in the Battle of Rubber.

[Next month—Other sources of rubber: guayule, kok-saghyz, cryptostegia, chilte, chrysil, norepol.]

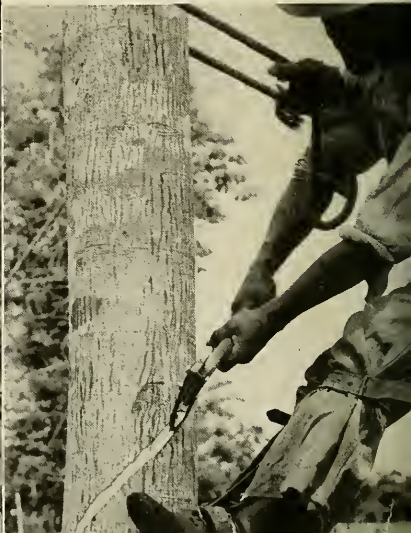


◂ Toasting wild rubber sap into balls for transportation from the jungle
(Kurt Severin, from Black Star)

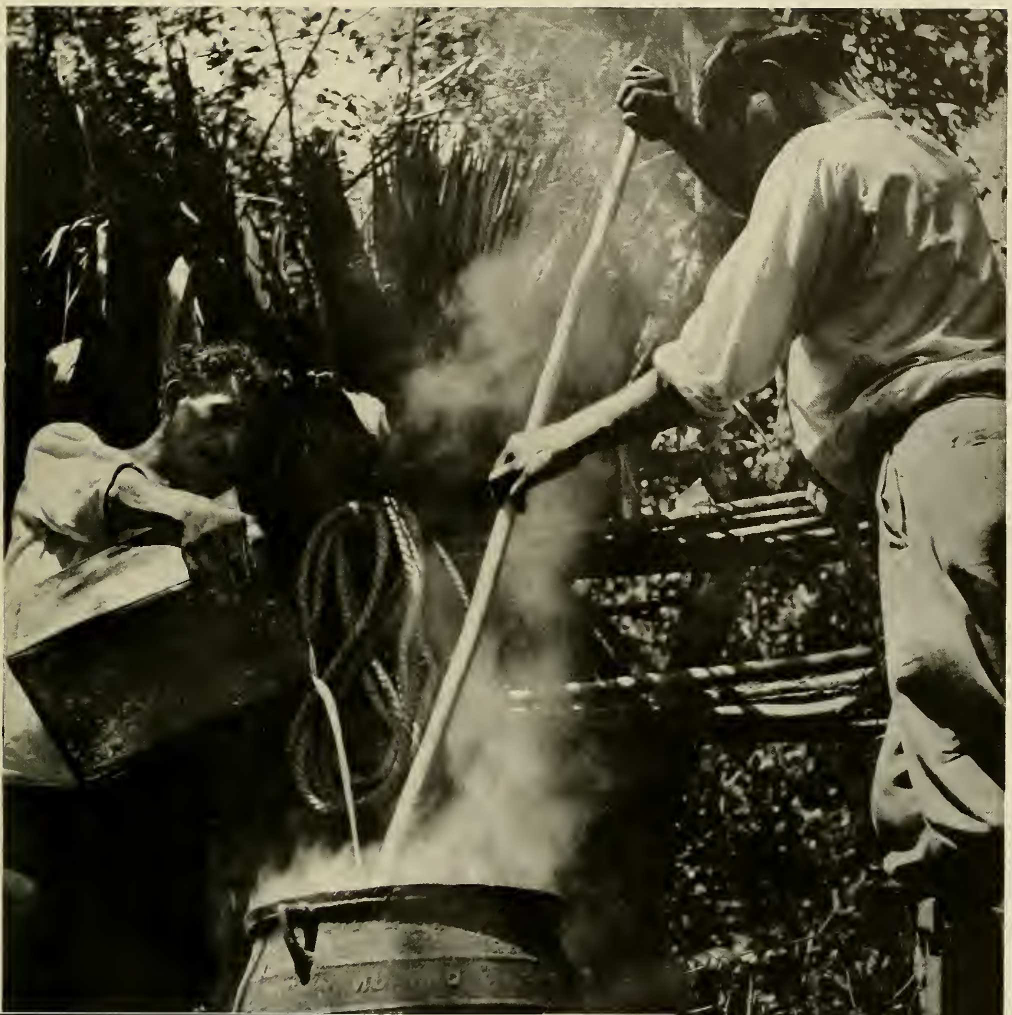
◂ Re-development of rubber resources in tropical America has brought into action one of the largest public health programs on record. Left, a worker in Brazil sprays a swampy area in a rubber region to prevent the breeding of malaria mosquitoes. Hospitals and mobile dispensaries have been established along the waterways and other routes, and dairy farms have been organized to support a new population in the wilderness
(U. S. Army photo from Three Lions)

◂ New impetus to a type of rubber cultivation inactive since the East Indian boom: a "plantation" of *Castilla* seedlings at the experimental station of the U. S. Department of Agriculture at Coconut Grove, Florida
(Photo by Gilbert L. Campbell)

(*Lower left*) Planting seedlings in the Fordlandia rubber plantation in Brazil: part of a long term plan to make the Western Hemisphere independent in this vital product
(Kurt Severin, from Black Star)



▾ A Costa Rican workman, supported by shoe irons and rope, taps a *Castilla* tree
(Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Dept. of Agriculture)



Severin photo from Black Star

▲ COOKING RUBBER in Brazil

Three Lions

◀ LOADING RUBBER into a plane in the Amazon country: rapid transit for a scarce commodity which formerly traversed the long, lazy cargo route from the East

YOUR NEW BOOKS

THOMAS BARBOUR'S AUTOBIOGRAPHY ● THE RAFT BOOK
GEOGRAPHY OF LATIN AMERICA ● MAN: REAL AND IDEAL

THE RAFT BOOK

- - - - - - - - - by Harold Gatty

George Grady Press, $3.25

CAPTAIN GATTY, of the Royal Australian Naval Air Forces, was the navigator of the late Wiley Post on their epic two-man flight around the world. Coming recently to the United States from the battle zone "down under," he set about the completion and publication of a "survival text" for the benefit of castaways. In scholarly conception, imaginative charm, breadth and variety of data submitted, richness and vividness of illustration, outright practicality, and beauty of make-up, this book is easily the leader among several issued with the same purpose since the outbreak of the war. It is a bibliophile's treasure, in addition to its usefulness. The Museum takes pride in the author's generous acknowledgment of assistance in the final stages of preparation by members of its scientific staff.

Like all master navigators, Captain Gatty realizes that pathfinding at sea is an ancient talent, still possible under force of necessity by the simple means available to Columbus, or to the Viking, Phoenician, and Polynesian voyagers who long antedated the Great Admiral. That fact, indeed, is the thesis of his work, of which the opening sentence reads: "This book has been written for those who, without previous experience in navigation and without navigating instruments, find themselves in small craft in the open sea and who have to make their way to land."

Within the space allowed, the only way to indicate the scope of the book is to list a number of its 29 sections: Migratory Birds as Winged Pilots; Migration of Insects; Land-sighting Birds as Navigating Instruments; Land Indications from Sea Birds; Fish and Other Surface Life; The Scent of Land; The Sky as an Indicator of Land; Directions from the Waves and Swells; Ocean Currents and the Color of the Sea; Estimation of Distance; Use of the Base Chart; Measurement of Angles; How the Polynesians Used the Stars; Directions from the Sun and Moon; How Far You are North or South; Winds, Ocean Currents and Temperatures; Ocean Rainfall Charts; Making the Landing.

There are 29 plates, of which 14 are printed in two or more colors. These illustrate the stars, representative sea birds of all oceans (by Jaques), cloud reflections from land masses below the horizon, wave forms adjacent to islands, and ocean currents. Twenty-two additional figures include typical high-seas fishes and other organisms, diagrams of rule of thumb navigational methods, etc. There are also two ingenious folded charts, one transparent and double-sided for star recognition and plotting, the other a world map with detailed supplementary information and tables revealing the length of the day and the true direction of the sun for all dates and geographical positions.

R. C. M.

WATERFOWL IN IOWA

- - - - by Jack W. Musgrove and
Mary R. Musgrove

State Conservation Commission,
Des Moines, Iowa, $1.00

THIS convenient little volume presents in concise form many salient facts concerning the characteristics of the 34 species and subspecies of waterfowl that have been recorded with certainty from the State of Iowa; ten additional forms are more briefly mentioned, two of them as of accidental occurrence and eight as hypothetical.

Uniform treatment is accorded the forms of positive occurrence, with the same sequence of paragraphs on "description," "field marks," "call," "breeding range," "migrations," "winter range," "nesting," "food," and "Iowa status." It is thus easy to make comparisons among the various forms in respect to any of these factors. The simple "description" is expanded when necessary to cover the various plumages of age, sex, and season, and the account is kept as simple as is consistent with clarity. A series of eight excellent colored plates by Maynard F. Reece illustrates 36 of the forms in various plumages, and assists pronouncedly in the identifications that may be needed. Length, weight, and a variety of vernacular names are given also for each species or subspecies. A synoptic key and plates of the general topography of a duck and of certain morphological details are further aids.

With this book, then, an observer in Iowa, and there are many hunters and others whose interest in birds does not go far beyond the game birds, should be able to satisfy himself as to the identity of the ducks, geese, and swans that he may encounter in the state. Since these birds have wide ranges, there are many regions apart from Iowa where the volume should be of much service. Apart from the simple identification of species, there also is much information on behavior and other characteristics that will be found of interest. Appended chapters deal with such things as variations in waterfowl plumage, migrations and flyways, enemies, and lead poisoning. A systematic list of all North American forms of the order is added, and a glossary of technical terms and an index to the scientific and vernacular names are supplied.

The work is not intended as a technical treatise but rather as an aid to those who would become better acquainted with this interesting group of birds within the limits covered by the title. As such it should meet a ready and deserved welcome.

JOHN T. ZIMMER.

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NATURALIST AT LARGE

- - - - - - - - by Thomas Barbour

Boston: Little, Brown & Co. An Atlantic
Monthly Press Book, $3.50

THE reviewer wonders, while devouring this sprightly and highly personal autobiography, whether its fascination is wholly intrinsic or whether the common conditioning of author and reader may not weight the scales heavily in its favor. Only time and the general response can answer that question. Most of us tune easily to the great natural history books we know by heart, the parts of the world we have seen or dreamt about, the heroes whose disciples we aspire to be, or their worthy successors whose comradeship we share.

Possibly Doctor Barbour has written only for such as belong to his tradition. Certainly for every naturalist and every museum man he holds up a glass that reflects fragments of the past, the present, and the things to come.

Few men have seen as much of creation as the author; few in middle life have attained half his deep human contacts; still fewer have kept such a clear, detailed, and uninhibited record. To an extraordinary degree he leads us into a charmed circle that centers in the bosom of his family and stretches spaciously outward and backward.

The organization of the book is *sui generis* and, in small part, repetitive. Certain sections, charming in themselves, seem unrelated to adjacent text. Yet, in the end, the jumbles complete their pattern under the three main headings, "The Making of a Naturalist," "The Sedentary Naturalist," and "The Leisurely Naturalist," comprising in all 24 chapters.

Stirring passages are too numerous to cite, but are exemplified in the wedding journey through the East Indies, the locust storm in South Africa, and the memorial to the author's son. Humor is plentiful and explosive. When Barbour asked Mr. Lowell, "Why doesn't the present generation produce any of the curious figures that stalked across the Harvard stage a generation ago?" the President replied, "Buy a mirror."

But was Doctor Barbour's tongue in or out of his cheek when he wrote: "Harvard and Brazil have long been allies"(?).

R. C. M.

GARDEN ISLANDS OF THE GREAT EAST

- - - - - - - - by David Fairchild

Charles Scribner's Sons, $3.75

DR. DAVID FAIRCHILD first visited Java and other East Indian islands in 1895, as a young botanist. Between that time and his return to the region in 1940 he had continuously worked as an enthusiastic plant explorer of the whole world, especially of the tropics. His recent book is a delightful account of several months spent chiefly in the Philippine Islands, Celebes, and the Moluccas, collecting for the Fairchild Tropical Garden in Florida. The collections on the trip numbered 500 different kinds of plants, including 90-odd species of palms and many kinds of tropical fruits to be tested in the experimental gardens.

It is fortunate that Doctor Fairchild decided to make the trip in spite of the war in the East and the possibilities of its spreading, as it did, to the islands of the South, for he is probably the last collector to visit these regions for some time; he is also probably the last traveler to set down his impressions of the various native cultures as they were but may not be again after war has rolled over and back. He is a sympathetic visitor in these regions, and his evaluation of life as it is lived there is high. The narrative is fresh and youthful in enthusiasms, and the story is of that ingratiating kind that takes the reader along on the trip, sharing all the delights of such a journey.

Perhaps the reviewer also should stress the point made by the author, which must represent one of his dearest hopes for the advancement of his science: "the fact that the possibilities of thousands of tropical plants still remain to be investigated by the people of the temperate zones." This book should surely provide the stimulus for the continuation of Doctor Fairchild's work. The illustrations are from photographs taken by the author and Edward Beckwith.

HENRY C. RAVEN.

GEOGRAPHY OF LATIN AMERICA

- - - - - - - - - by Fred A. Carlson

Prentice-Hall, $6.00

THIS is a revised edition of a standard work that had already required five printings since its original appearance seven years ago. The new book is well justified by the strengthening of inter-American friendship that has resulted from our own growing interest in Latin American nations, "not only on the part of officials of the Government and leaders in education but also on the part of the public as a whole."

In addition to bringing all statistical and geographical information up to date, Professor Carlson has added extensively to his earlier text, the new material including a chapter on the cultural heritage of Latin America and another on evolution of the political pattern in the numerous republics. The former chapter deals in summary with the pre-Columbian civilizations, the earlier and recent phases of immigration, the place of the transplanted Negro (of which there are 23 million south of the United States), and the general cultural characteristics and outlook. Such subjects are treated also with added but not overlapping detail in later sections, such as that dealing with Japanese settlement in Brazil. All the chapters of the book are followed by well selected lists of references.

The bulk of the work is devoted to geographic description of two inclusive areas,

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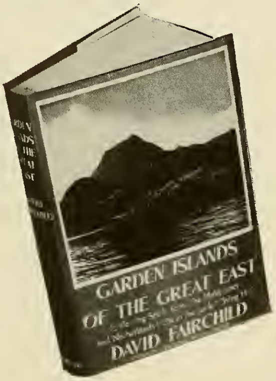

Garden Islands
OF THE
Great East
by
David Fairchild

author of "The World Was My Garden"

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★

Man: Real and Ideal
by
Edwin Grant Conklin

President, the American Philosophical Society, Emeritus Professor of Biology in Princeton University

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namely, "South America" and "Central America, Mexico, and the West Indies," and to chapters on the various sovereignties or colonies. Discussion of Brazil fills five chapters, that of the West Indies four, that of Mexico three. Final chapters are devoted to transportation, commercial relations, and a summary, besides which there are useful appendixes relating to population statistics. European possessions, and the pronunciation of geographic names.

The photographic illustrations, maps, diagrams, and tabulated information are well designed with relation to supplementing and clarifying the text. There is perhaps no other book that offers as much comprehensive and authoritative information on Latin America within equal space.

R. C. M.

OUR LIVING WORLD

- - - - - by Carroll Lane Fenton

Doubleday, Doran and Company, Inc. $4.50

THIS book was obviously planned on a grand scale and aimed toward extremely comprehensive objectives. In 296 pages the author attempts to give the nonscientific reader an over-all picture of "the history of life on earth."

The author starts his story with an evaluation of the various theories of the origin of life on earth and proceeds to describe the general characteristics of all protoplasm. The main outlines of evolution are sketched in, and major principles of physiology, especially those concerned with the ingestion and utilization of food, are presented. The sensory and motor equipment of representative organisms of various phylogenetic levels is briefly described. Evidence for modifiability of behavior in the lower as well as the higher animals is set forth; and the relationship of learning to the central nervous system is stressed.

Various types of asexual and sexual reproduction are explained, and the skeleton facts of embryological development are described. Elementary principles of genetics are discussed, and the application of such principles to problems of domestication and miscegenation are called to the reader's attention.

A few generalizations about ecology appear, and problems of geographic distribution as related to evolution are described. The development of the human type, including some mention of the beginings of various cultures, is discarded.

The foregoing summary plainly indicates the ambitious nature of the book's plan. To what extent the author's ambitions are realized will depend upon the requirements of the individual reader.

F. A. B.

MAN, REAL AND IDEAL

- - - - - by Edwin Grant Conklin

Charles Scribner's Sons, $2.50

THIS popular philosophical discussion is based mainly upon a series of lectures delivered in 1941 on the Sharp Foundation of the Rice Institute. Doctor Conklin, the author, was Professor of Zoology in Princeton University for a quarter of a century, becoming Professor Emeritus in 1933. Since that time he has been special lecturer in biology. He was Lowell lecturer in 1922, President of the American Association for the Advancement of Science in 1936, and is now President of the American Philosophical Society.

Many persons will welcome a book from a mature student of such renown on the subject, "What is man?" And here we have a fascinating, non-technical treatment of the question, which the author has divided into three parts. The first is entitled "The Human Species," in which man is dealt with from the biological point of view. In this he discusses species, races, and tribes of men, evolution, natural selection, and the rôle of eugenics. The second part, entitled "Development of the Individual," is the biological story of man, both physical and psychological, including social and moral development. The third and last part, referred to by Doctor Conklin as "The Real and the Ideal," is made up of most readable summaries of the struggles of science versus tradition, such as, the Copernican theory vs. a central stationary earth, the law of gravity vs. supernaturalism, and natural evolution vs. supernatural creation.

He discusses the question, What kind of religion does science leave to man? "The supreme social service of religion," says Doctor Conklin, "is to breathe into the realism of science the spirit of lofty idealism; to cultivate among all classes, races, and nations of men, justice, peace, and mutual service. The needs for such religion are universal and eternal."

CLYDE FISHER.

The price of *Archeological Studies in Peru*, 1941-1942, a review of which appeared in the September NATURAL HISTORY, has been raised from $3.75 to $4.75.

ON YOUR RADIO

Program of the American Museum of Natural History, Fall, 1943.

WEDNESDAYS over WNYC
from 3:30 to 3:45 P.M.
Science for the Seven Million

Nov. 3—*Camouflage*
Nov. 10—*Black Market Dangers*
Nov. 17—*Greenland and Iceland*
Nov. 24—*Thanksgiving Program*

This program is now under the sponsorship of NATURAL HISTORY Magazine.

URGENT

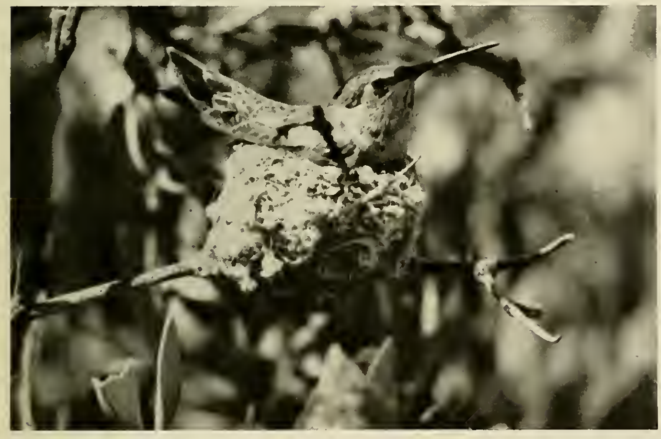
The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, Natural History, New York, will be greatly appreciated.

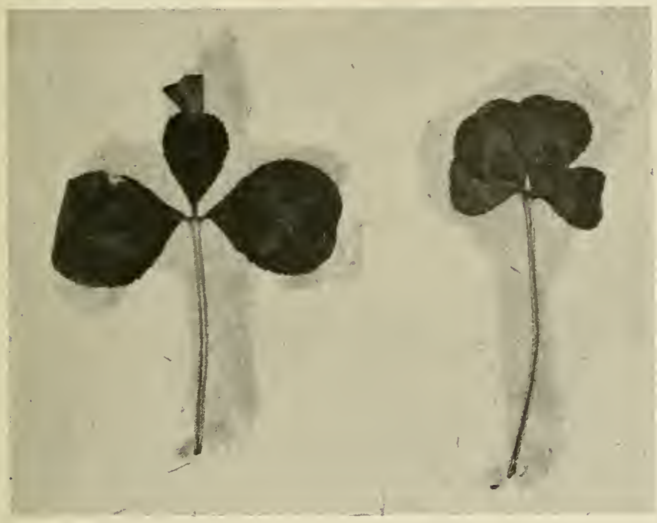
LETTERS

SIRS:

Having noticed your photograph of the Ruby-throated Hummingbird in the October issue of NATURAL HISTORY Magazine, we thought you might be interested in this picture of the Costa's Hummingbird brooding her eggs, which was taken in Arizona. The camera, a Zeiss Trona with an f. 4.5 lens, was about 24 inches from the bird. As those who have had the opportunity to see the bird will realize, it is only about three and a half inches from the tip of its bill to the tip of the tail.

HARRY L. and RUTH CROCKETT.
Phoenix, Arizona.





SIRS:

Yours is one of the most informative and interesting magazines on the market. My sister, who is a subscriber, gives me the pleasure of reading it . . .

I am enclosing a five-leaf clover and one closely resembling the "cornucopia" in Mark Barr's "Clover Hobby" in the September issue . . . TONY EBERTS.
Barriere, British Columbia.

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

A "Dublin" shape Kaywoodie, $3.50.

"I Smoke a Kaywoodie"

This *Mediterranean briar brought here before the War*, is the kind they've used 100 years for the finest pipes. In Kaywoodie, it is cured with tempering agents that permeate it. It yields the greatest satisfaction. That's why you hear them say "I smoke a Kaywoodie," *all over the world.*

If you've had a pipe of apple wood, dogwood or maple, you know they don't taste like Kaywoodie. Look for "Kaywoodie," cut unobtrusively on the pipe.

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WAR
BONDS

Adventures of
LONGINES
THE WORLD'S MOST HONORED WATCH
The watch that was recalled to service*

Thousands of men bought their first Longines strap watches while serving in World War I. The Longines military watch above was bought by an American Artillery Officer from the Quartermaster Corps in France in 1918 and received its baptism of fire in the decisive St. Mihiel and Meuse-Argonne battles. For 10 years after the war, it shared the rough and ready life on a Montana ranch, and then it was put aside. ¶Suddenly, the years of peace ran out and war came again. Our Artillery Officer was called for active duty, and the old Longines military watch was recalled to service. ¶Countless of such incidents have made the reputation of Longines watches—for keeping good time for a long, long time.

*Based on documents in our files

Longines-Wittnauer Watch Co., Inc., New York, Montreal, Geneva; also makers of the Wittnauer Watch, a companion product of unusual merit.

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AND 28 GOLD MEDAL AWARDS

The beating heart of every Longines Watch is the Longines "Observatory Movement,*" world honored for greater accuracy and long life. *Reg. U. S. Pat. Off.

SIRS:

The October number is marvelous, but I am appalled at the number of words I cannot pronounce, especially the names of the flying reptiles. I do wish the pronunciation of the technical words might be given. Is there a dictionary of biological terms? . . .

MRS. W. H. CONNELL,
Head of Biology Department,
Hot Springs High School.
Hot Springs, Arkansas.

Unfortunately there is apparently no complete, special dictionary giving the pronunciations of biological terms. However, when neither Webster's New International nor the unabridged Century gives the full word, its pronunciation and derivation can frequently be pieced together by finding its parts separately in the main section of the dictionary, where they are frequently entered alphabetically as "combining forms."

Representing the pronunciation as simply as possible, the flying reptiles would be:

Pteranodon=*ter-an'-o-don*
Nyctosaurus=*nick-to-soar'-us*
Dimorphodon=*dye-mor'-fo-don*
Campylognathus=*cam-pill-og-na'-thus*
Dorygnathus=*dor-ig-na'-thus*
Scaphognathus=*scaf-og-na'-thus*
Rhamphorhynchus=*ram-fo-ring'-kus*
Cycnorhamphus=*sick-nor-am'-fuss*
Pterodactylus=*ter-o-dack'-till-us*

* * *

SIRS:

Am in receipt of the October issue and am so taken with the cover picture of the Lion's Paw Shell that I am writing to tell you it is the finest thing I have ever seen.

Having spent many years on the Florida west coast, I have several fine shells of the species and know the thrill of finding them. This picture brings back the days on the beaches, and I live again the finding of five live ones after a storm.

I have been told that copies may be purchased, and if this is so, please advise me, as I wish my shell-loving friends to share this with me. WILBUR F. SMITH.
South Norwalk, Conn.

Separate copies of the cover designs of NATURAL HISTORY Magazine are frequently requested for educational purposes and as wall decorations. Most of those that have appeared in recent years are available, including the one referred to above. The price is 5¢ each, plus 5¢ mailing charges on any number up to ten.—ED.

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Natural History
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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope
Akeley African Hall—American Museum of Natural History

Our Research Obligations

IN last month's issue we dealt with research as an essential requirement for the successful performance of our tasks in public education. But research is not only a need for our own benefit in the pursuit of other duties, it is also an inescapable moral obligation arising from the unlimited extent of our borrowings from the knowledge created by others and from the richness of scientific materials to which we claim possession.

To fulfill its educational duties every museum must draw upon the body of scientific knowledge built up by centuries of patient and diligent research for which past generations willingly provided the means. If the museums of today do not continue to contribute to the sciences from which they borrow they become parasites upon the civilization to which they belong. They take on the character of the person who reads all the magazines in the store but never buys one. The cost of research is the subscription price each museum has to pay for the moral right to use the knowledge created by the effort and expense of others. It should be incumbent upon every museum to meet this obligation according to its size and to the extent of its borrowings from science.

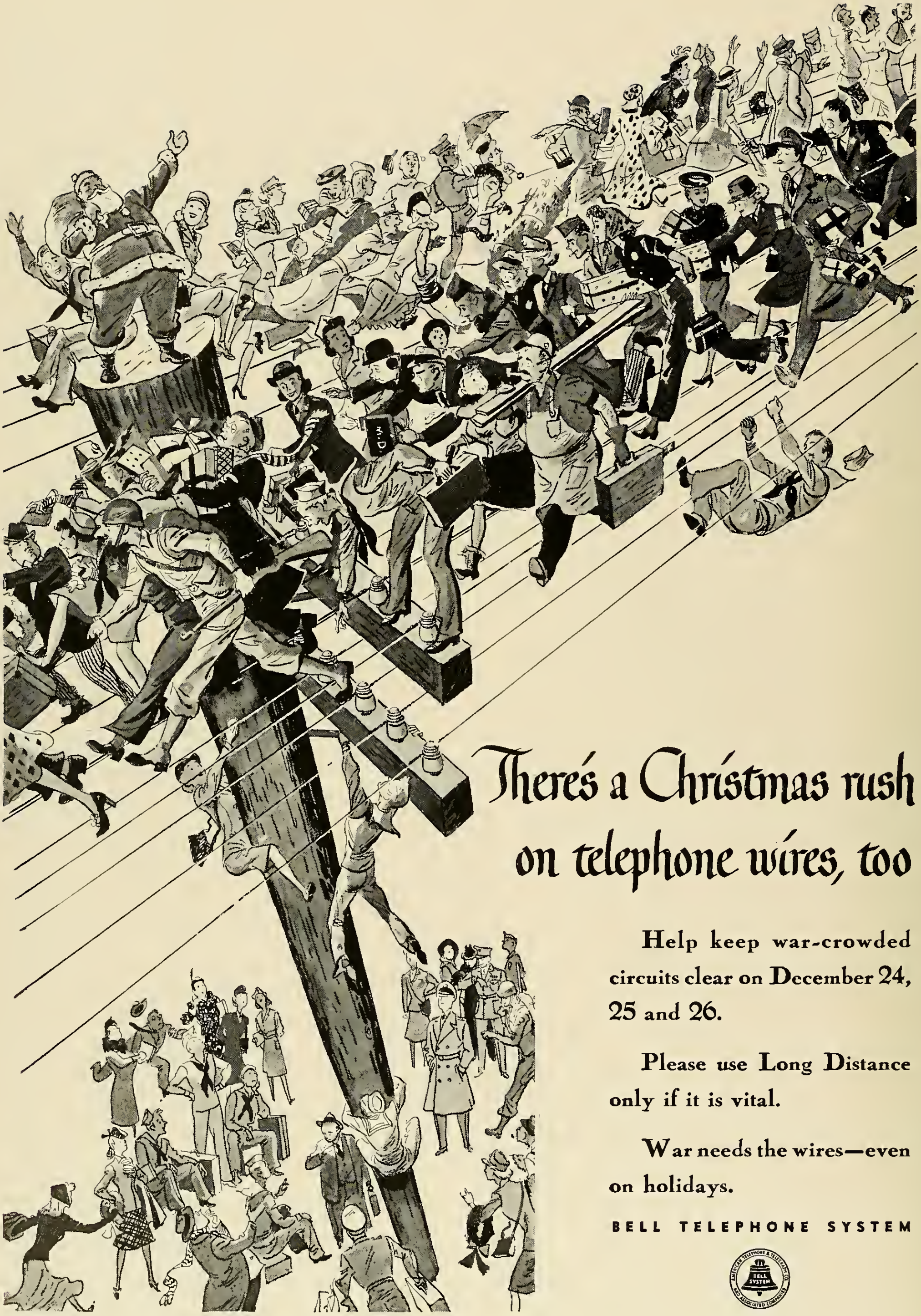
It is particularly true of the museums of natural history that if they should *all* adopt the parasitic way of life there would no longer be any host for them to prey upon. A large part of the knowledge with which these museums are dealing originated with them and has to a singular and increasing degree become dependent upon the type of facilities for research which only the museums are able to offer.

The second consideration which makes research an obligation upon any major museum is a purely practical one. It is obvious that if any museum for its own gratification and glorification insists on retaining major collections of scientific material without also undertaking to do the necessary research upon these collections, it is actually taking a false and reprehensible pride in being an obstacle to the true progress of science. By neglect of its moral obligations the museum forces the scientific world to conduct its research activities in places divorced from the best research material, to the inconvenience of the investigator and the delay of scientific progress.

Our moral right to pride ourselves upon our scientific collections, and even our right to retain them in our possession, must therefore lapse with our failure to continue our active participation in research upon the subjects covered by the material.

A. E. Parr

*Director, The American Museum
of Natural History*



There's a Christmas rush on telephone wires, too

Help keep war-crowded circuits clear on December 24, 25 and 26.

Please use Long Distance only if it is vital.

War needs the wires—even on holidays.

BELL TELEPHONE SYSTEM

December

NATURAL HISTORY

1943

Wildlife & Weather in Asia · Stratosphere & Beyond

Meet Mr. Woodchuck · Rubber Sources · Snake Venoms

FIFTY CENTS

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

LETTERS

Sirs:

Congratulations on your beautiful cover for the October issue [Lion's Paw Shell]. I thoroughly enjoyed your article "Flying Reptiles" by Barnum Brown, and I hope there will be others on the restoration of prehistoric reptiles. Few can compete with a periodical as interesting and as educational as this magazine has proven itself to be. . . .

David Holman.

San Francisco, Calif.

* * *

Sirs:

In spite of my failing vision (I am 81), which compels me to read with a hand lens, I am loathe to discontinue my Natural History Magazine, so am sending my subscription for another year.

I recently acquired a binder for the preceding ten months and much enjoy looking over the numbers contained therein. I find that after a few months they seem almost new. Others, too, find pleasure in looking at them. There is no other magazine to compare with it. . . .

R. A. Clark.

Springfield, Mass.

* * *

Sirs:

. . . A splendid article and pictures on the new volcano in Mexico. I was a visitor there this summer. . . .

Marguerite Kyle.

Columbus, Ohio.

* * *

Sirs:

In couplet form I write to you
Extending thanks, long overdue,
For your outstanding publications,
Enlivened by rich illustrations
And voicing real authority
In just superiority.

Almost as soon as it's inspected,
Natural History's dissected,
And used to teach biology
Or illustrate geology.
The bulletin board it's tacked upon,
Or used in the Balopticon
To supplement prosaic text
Or help a pupil (who's perplexed)
To visualize remotest ages,
That leap to life upon its pages.

I would presume, now, to suggest
How to improve upon the best:
On *every* page a number, so
I can assign, and surely know
The most obtuse will always find
The reference I had in mind.

Today your letter did remind
Me that subscription is behind.
So, for this pedagogic jewel,
Accept four dollars, for renewal.

Allen F. Brown,
Instructor in Science,
Mayfield Central School.

Mayfield, New York.

The headache numbering pages where
A photograph's already there—
Is almost worse
Than writing verse.—Ed.

* * *

Sirs:

I am fourteen years of age and live near a neighbor who is fortunate enough to read your excellent magazine and generous enough to pass the copies on to me. The covers are absolutely gorgeous, and I read everything between them. I am especially enchanted by Roy L. Abbott's stories.

I am enclosing 40¢ in stamps for the cover designs of eight magazines which I

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

The Perfect Christmas Gift for Any Boy or Girl

Junior Natural History Magazine

•

$1.00 the year
(12 issues)

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AMERICAN MUSEUM OF NATURAL HISTORY
79th Street at Central Park West
New York 24, New York

have listed below, if they are available. . . .

BORIS B. SHAHON.
Rhinebeck, N. Y.

Most of the full-color cover designs that have appeared on NATURAL HISTORY in recent years are available. The cost is 5¢ each, plus 5¢ mailing charges on any number up to ten pictures.—ED.

* * *

Other comments of the month:

From a relative of a man overseas:
". . . I understand that the officers of his outfit, which is in the Southwest Pacific, eagerly await the arrival of the magazine every month. . . ."

• • •

". . . I have been a subscriber to your magazine for a number of years and think it is the most valuable and interesting magazine I have read. . . ."

• • •

". . . It is the most beautiful magazine there is. . . . Do hope when you build a modern building that it will have the elegance of your magazine . . . modern to the nth degree but beautifully so. . . ."

• • •

". . . We enjoy the magazine so much we like to introduce it to our friends. . . ."

THE COVER THIS MONTH

December NATURAL HISTORY 1943
Wildlife & Weather in Asia · Stratosphere & Beyond
Meet Mr. Woodchuck · Rubber Sources · Snake Venoms
FIFTY CENTS

Most plants cannot live without leaves. The green coloring matter they contain, chlorophyll, is essential in converting minerals from the soil into nourishment through the action of sunlight. Yet the brilliant red Snow Plants on the cover of this issue have no green leaves. They survive without benefit of chlorophyll, by deriving their nourishment from decayed matter or from soil fungi found among the roots of evergreen trees. Plants which get their nourishment in this way are called saprophytes. Snow Plants, which have the scientific name *Sarcodes sanguinea*, grow in the High Sierras of California, where Josef Muench took this photograph in color. Sometimes they appear early in the spring while the snow is still on the ground. There is a heavy fine for picking them.

Tae anither-r Yuletide!

Teacher's has been a favorite at Yuletide festivities ever since 1830 . . . and with good reason. Three words tell the story:

"It's the flavour"

TEACHER'S HIGHLAND CREAM
Perfection of Blended Scotch Whisky
Teacher & Sons Ltd. Glasgow
86 PROOF
Made since 1830 by Wm. Teacher & Sons, Ltd., Glasgow
TEACHER'S
Perfection of Blended Scotch Whisky

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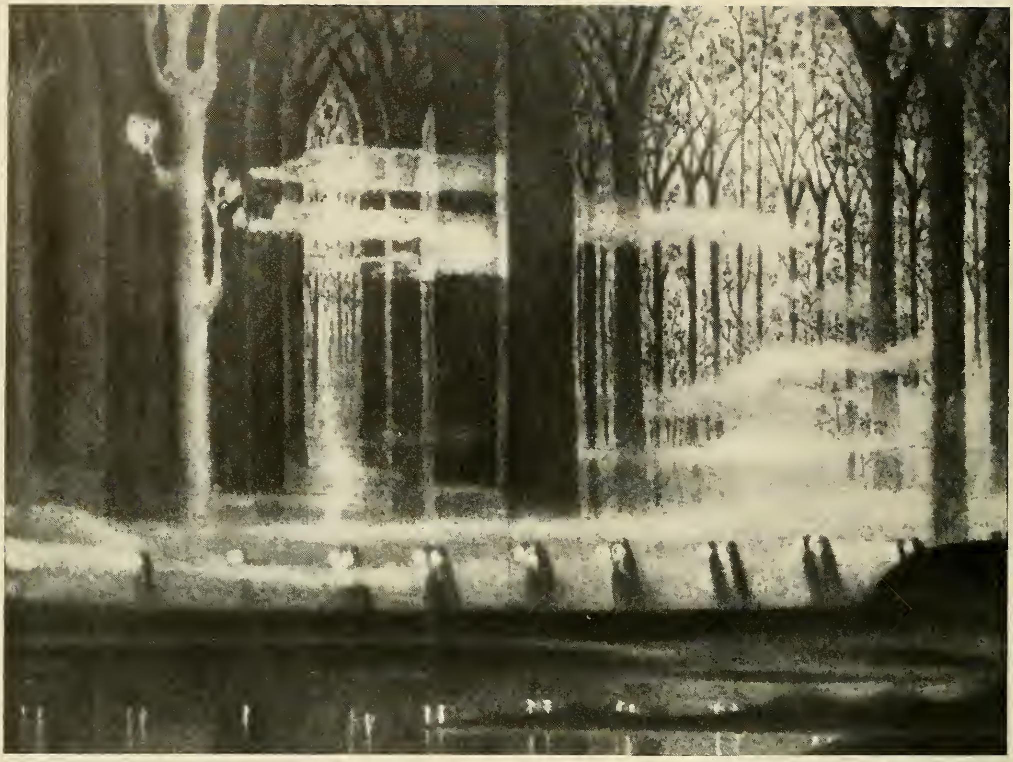


©Walt Disney Productions

What's the word you think most of at Christmas?

THERE'S one word men of good will everywhere associate with Christmas.

That word is *"Peace. Peace on earth"*...

There can be no peace this Christmas. Not one of us would want the only kind of peace there could be, an inconclusive peace.

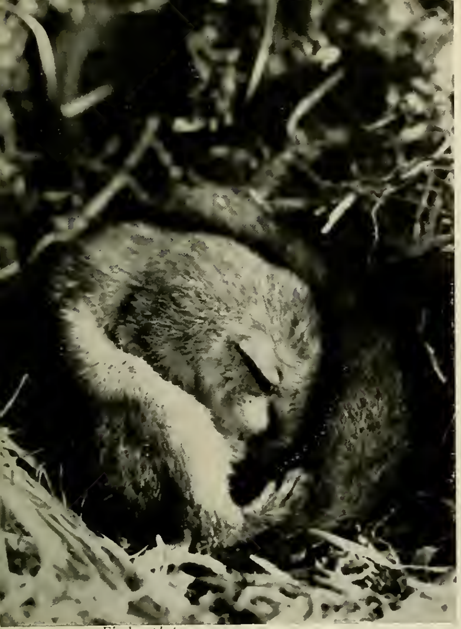
But we do want the right kind of peace as soon as possible. And this Christmas we can help hasten the coming of that wonderful day, by making War Bonds our chief gift.

Every Bond you buy brightens the chances of a better world than man has ever known.

How, then, could you possibly give a better present than Bonds, Bonds, Bonds? Give them to each member of the family. Give them to your friends. Give them to *everybody—the greatest gift of all!*

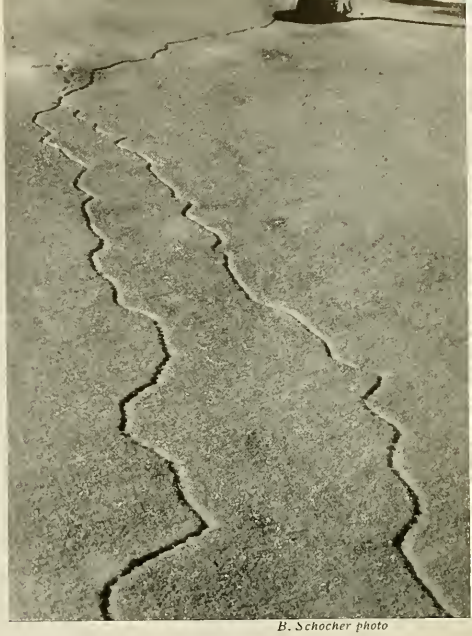
Give War Bonds for Christmas

★ NATURAL HISTORY Magazine ★



◄ A EUROPEAN DORMOUSE IN HIBERNATION

Fischer photo



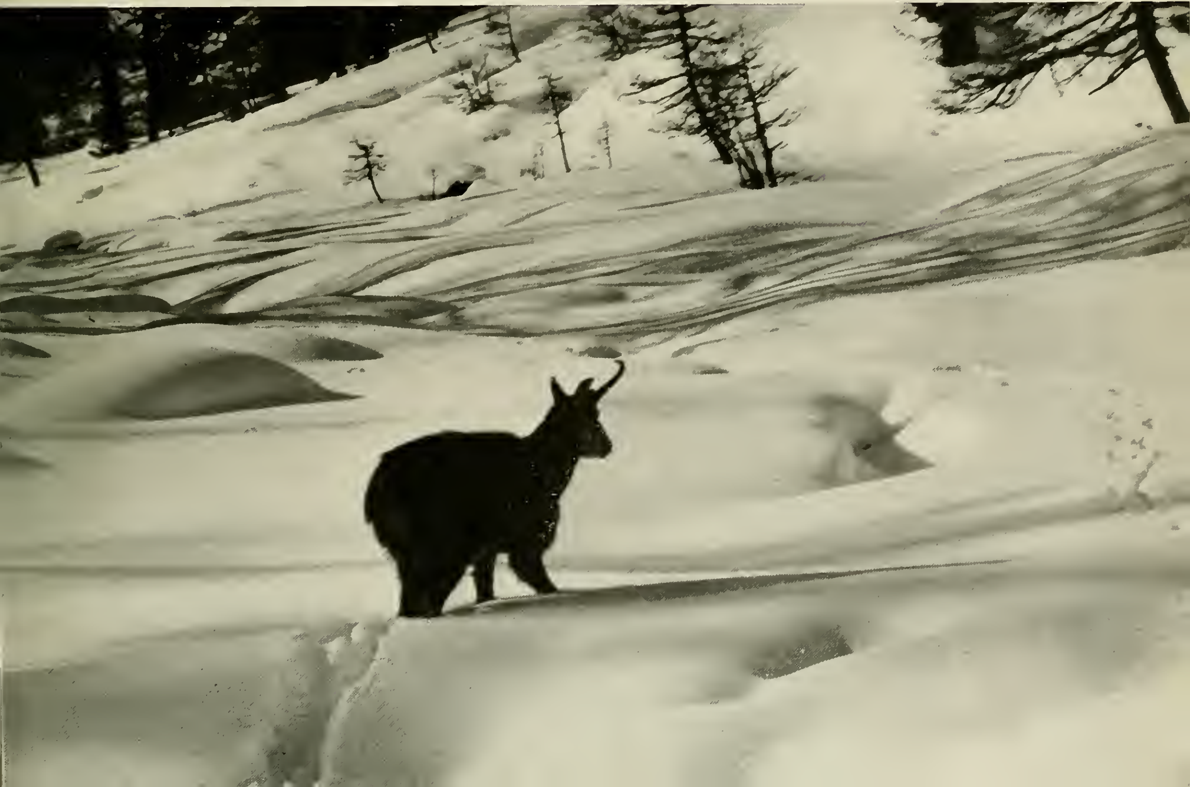
► WHERE SWISS FIELD MICE TOOK THEIR MORNING STROLL

B. Schocher photo

Seeing Nature *through* THE CAMERA'S EYE

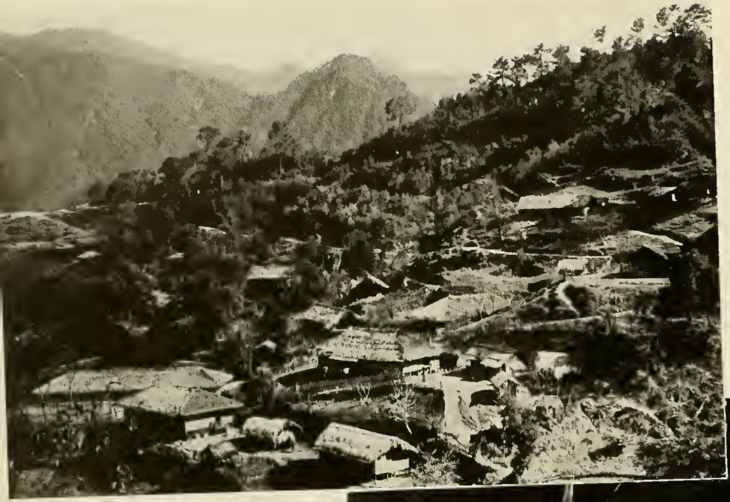
▼ AN OLD CHAMOIS IN A SWISS SNOWFIELD

B. Schocher photo



Wildlife an

The Burma Road is only one of many
things conditioned by the extraordinar
climate in that part of the Far East on which
the international spotlight now focuses



Vernay-Cutting Burma Expedition photo

▲ **The hill people** of Northern Burma are not concentrated in large communities but scattered in small villages. Occasionally the houses are located fairly close together in a community of several hundred. Htawgaw *(above)* was a base for military police before the war, and an important trading center for the back country. It is about one hundred miles north of the Burma Road

A.M.N.H. photo

➤ **This Tiger Group** in the American Museum shows an animal that has a wide range throughout southern Asia. In Burma, it extends up into the foothills but does not appear to be very abundant in the area where the Chinese are fighting the Japanese over the control of the Burma Road. Here the tiger would probably not be one of the hazards a lost man should fear

Weather IN THE Asiatic War Zone

By HAROLD E. ANTHONY

Chairman and Curator of Recent Mammals, American Museum of Natural History

To some it might seem that a natural history museum, in time of war, would be a back water in the current of active events, a place removed from the important interests of the day. This is far from the case.

The American Museum through its expeditions all over the world is able, at this time, to give valuable firsthand information on any of the active theatres of war and to present this data either to the proper military agencies in precise and detailed pattern or to the general public in a broader, more generalized aspect. The exhibits in the Hall of South Asiatic Mammals will serve to illustrate this thesis.

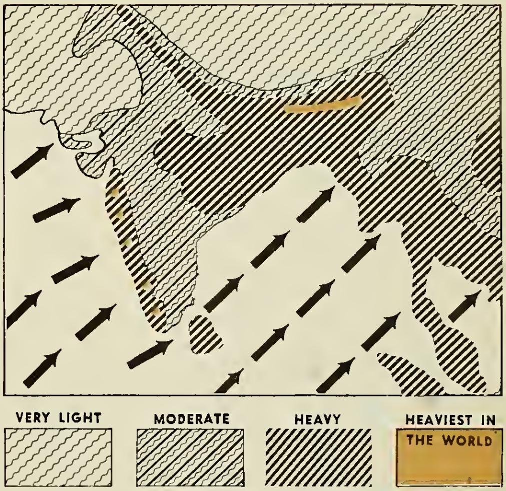
These exhibits were collected and the hall completed at a time when no thunderheads of war were gathering on the far horizon. Nevertheless, now that war has come into southern Asia these samples of topography, fauna, and flora will help to orient the Museum visitor in his armchair strategy as he follows operations through the daily press. In the early stages of the campaign in North Africa, the Libyan Desert Group in the Akeley African Hall was a useful example of some of the conditions to be encountered. Even more to the point was the fact that some of the sand used in the group, actual sand collected on the spot, could be turned over to military circles, where men were studying the effect of sand on the mechanical equipment. One of the occupational hazards was a silicosis attacking planes, tanks, and trucks which had to operate in sand-laden atmosphere.

With attention being directed to

THE MONSOON *and the World's Heaviest Rainfall*

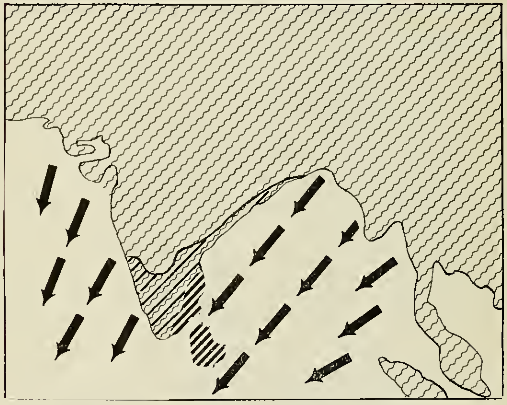
SUMMER →

DURING THE SUMMER the prevailing winds are across the Indian Ocean and the Bay of Bengal onto the land. These winds are heavily laden with moisture. As they are forced to rise by the mountains and cooled by the land, they drop their load of water

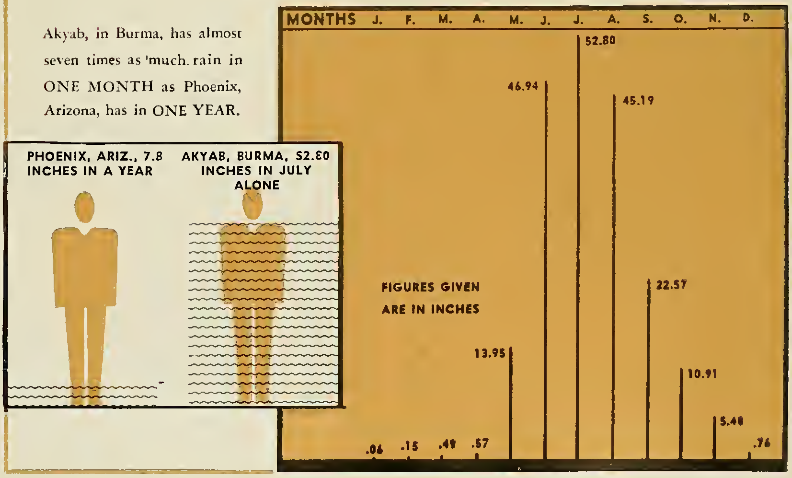


WINTER →

FROM NOVEMBER TO MARCH the winds blow off the land and are drying rather than moisture-laden. The remarkable thing about the Asiatic monsoons is the persistence and regularity of the cycle and the great area affected by the winds



THE RAINFALL CALENDAR shows that in Burma it is either a flood or a drought. In one month precipitation may be enough for the annual rainfall of a well-balanced climate. In other months, this same spot may have no more rain than the Sahara Desert



Akyab, in Burma, has almost seven times as much rain in ONE MONTH as Phoenix, Arizona, has in ONE YEAR.

BURMA—*focal point in the Asiatic theater-*

Vernay-Cutting Burma Expedition photos

mountainous

▲ THE DIVIDE BETWEEN YÜNNAN AND BURMA is a mountain range which, in many places, carries snow during the winter months. This highland divides the drainage of the Salween on the east from that of the Irrawaddy on the west and is known as the Salween Divide

jungle-clad

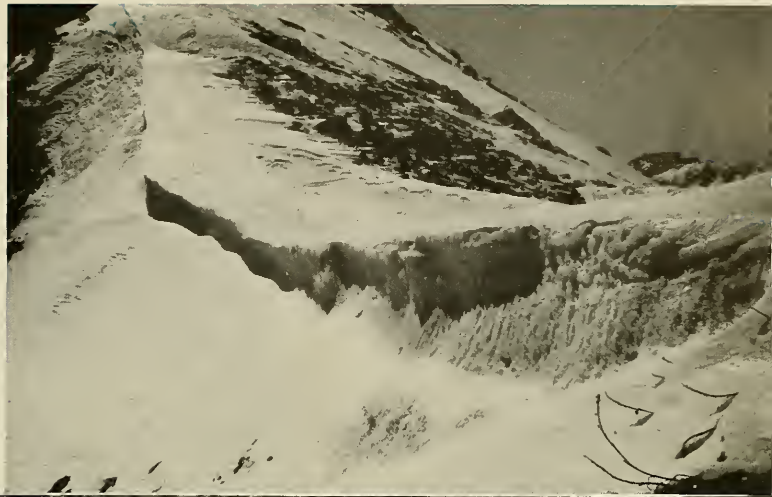
◀ DENSE JUNGLE clothes many of the mountain slopes at the intermediate elevations. Such places experience heavy rains during the wet season. Even throughout the dry season the foliage is damp from dew and every ravine carries running water

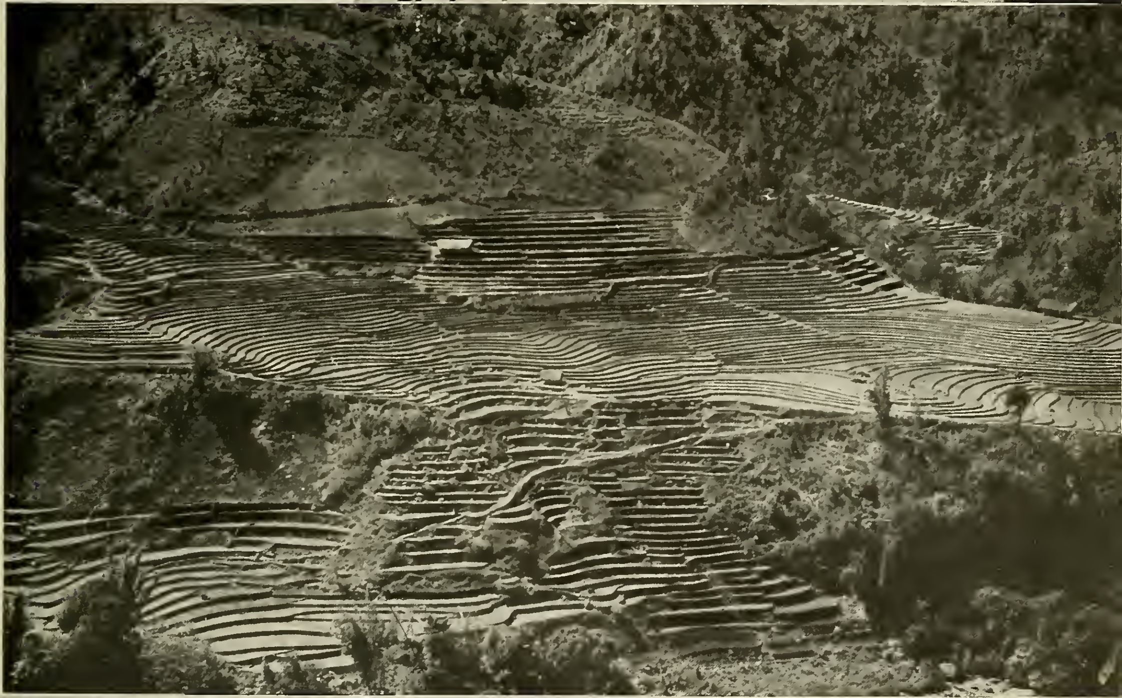
hot

▶ LONG HOT DAYS are the invariable rule in the lowlands during the dry season. Although clouds will bank up over the Irrawaddy below Rangoon, no rain will fall for weeks or even months on end s

cold

➤ ON THE HIGHER PASSES over the Salween Divide—here 12,600 feet in elevation—snow persists for several months. Then traffic must be on foot, for mules break through the crust and on rocky stretches may suffer broken legs





fertile

▲ A WELL LAID OUT RICE FIELD presents an interesting and beautiful geometrical pattern. This slope would be impossible to cultivate if it were not terraced, and it illustrates the engineering ability of the mountain people

◄ AT HPARE VILLAGE, near the Yünnan border, there is an unusually extensive Kachin agricultural community. The terraces have a hard retaining bank to prevent water from eroding the hillside

Burma as an ever increasingly active theatre of operations in this global war, the Hall of South Asiatic Mammals offers to the visitor a great deal of data which will make the information in the daily press more understandable. The habitat groups afford an insight into some of the terrain and the animal life which will be in the environment of the warring troops.

Burma occupies a strategic position, with the United Nations in India to the west, China to the east and northeast, and the Japanese forces of occupation in control of all of southern Burma and most of accessible northern Burma. However, Burma is a vast territory, too large to be completely overrun, and there are still sections which may be considered as a no man's land, especially in the northeastern part near the border with Yünnan.

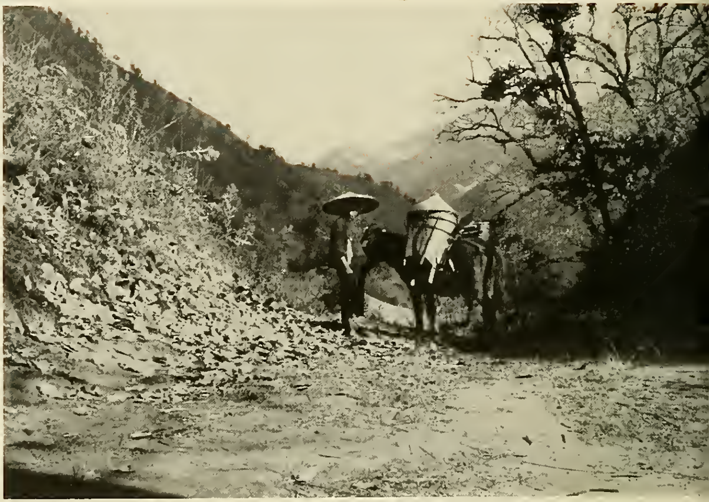
Burma has a wide range of environments. In the south, in the lower elevations, there are great hot tropical areas, which range from more or less open thorny scrub country to fairly dense jungle. In other parts mountain ramparts exist, which begin first as lower foothills and pass by degrees into the great ranges which merge into Tibet. There is nothing tropical about this section where the difficulty of travel is enough to hinder the movement of any large bodies of troops.

The dominant factor in moulding the topography of Burma and in regulating the character of its vegetation is the pattern of the annual rainfall. Burma is in the path of the monsoons, and while some of the areas receive very heavy rainfall during several months of the year, there are other periods when they receive practically no precipitation at all. Thus there is an extreme contrast between the two periods, the rainy season and the dry season. "Monsoon" comes from the Arabic and means "season," but one often notes the term used as if it were synonymous with the rainy season. Actually there is a dry monsoon and a wet monsoon, for early usage of the word had reference to the wind and the direction of the wind governs the rainfall.

When the rains come in southern Asia they are really something to write home about. The moisture-laden winds have picked up their water content from over a thousand miles or more of the warm waters to the southwest. The areas of greatest rainfall

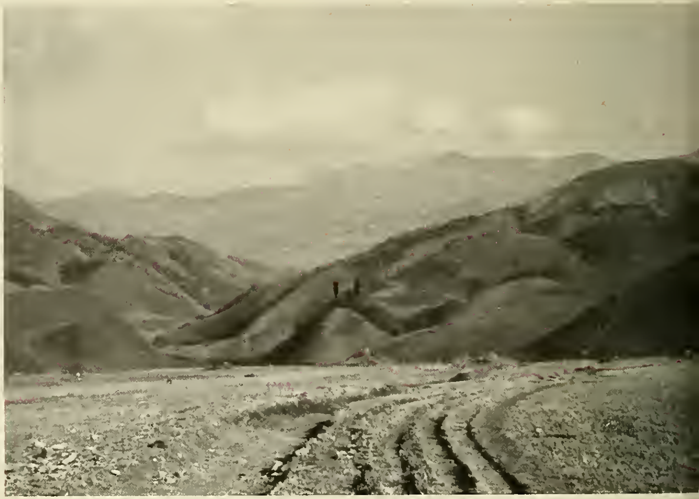
TRAVEL

rough trails



▲ THE MAIN HIGHWAYS in northeastern Burma lead into Yünnan and are well laid out, but the trails which feed into these trunk lines may be steep and precipitous. Mules are used on the main trails

desolate country



▲ THERE are not many regions in northeastern Burma as open as this grazing district near the Yünnan border. Here the forest is almost absent and the trail winds over rounded hillsides

indered by

rivers

▲ At Myitkyina, railhead of northeastern Burma, the Irrawaddy is still a broad stream. The native ferries are primitive canoes, which are poled a good part of the distance from Myitkyina across to Waingmaw

Vernay-Cutting Burma Expedition photos

inadequate bridges

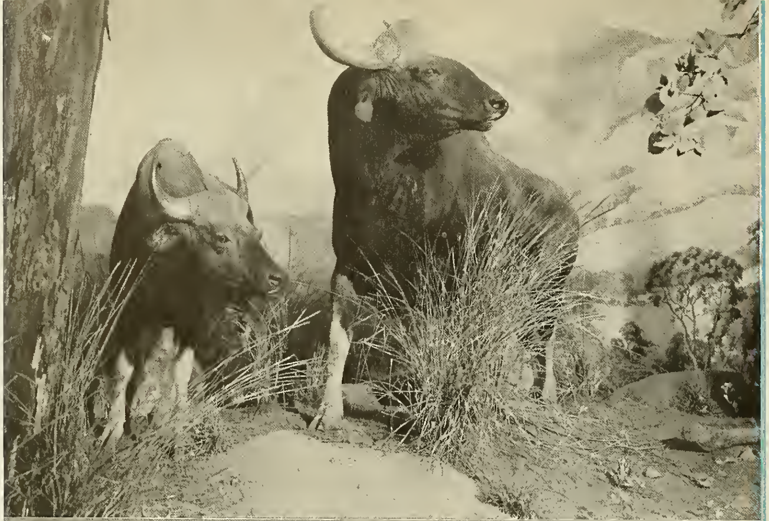
▲ The native bridges are ingenious affairs but require a sure foot and a steady eye. Usually they are suspension bridges and cross well above high water. This bridge will go out with the first heavy rains

are situated where the topography is such that these vapor-charged winds are forced to drop their water in going over a mountain barrier. Assam is one of the regions where the clouds are put through the wringer, so to speak, and the Khasi Hills, with an average annual rainfall of 427 inches, is said to have the heaviest precipitation in the world, where some of the lowland areas become virtual lakes of almost warm water. Incidentally, any sweeping statement claiming a maximum for the world provokes statistics in rebuttal. For example, at Maui in the Hawaiian Islands, an annual rainfall of 562 inches has been recorded. But perhaps after the first 400 inches of rain in any year it does not make much difference whether more falls or not, and it seems to be universally agreed that Assam and Burma are thoroughly wet.

The wet season in Burma may break with a storm of several days duration and an apparent suddenness following the long dry weeks. The *Burma Monthly Weather Review* publishes records from a number of official observation posts and shows that anything from five to ten inches of rain in a day is common on the first burst of the southwest monsoon. There may follow a period of intermittent dry and wet intervals until the wet season is in full stride. And it is noteworthy that, throughout the season, the *Weather Review* does not bother to record a daily precipitation of less than five inches.

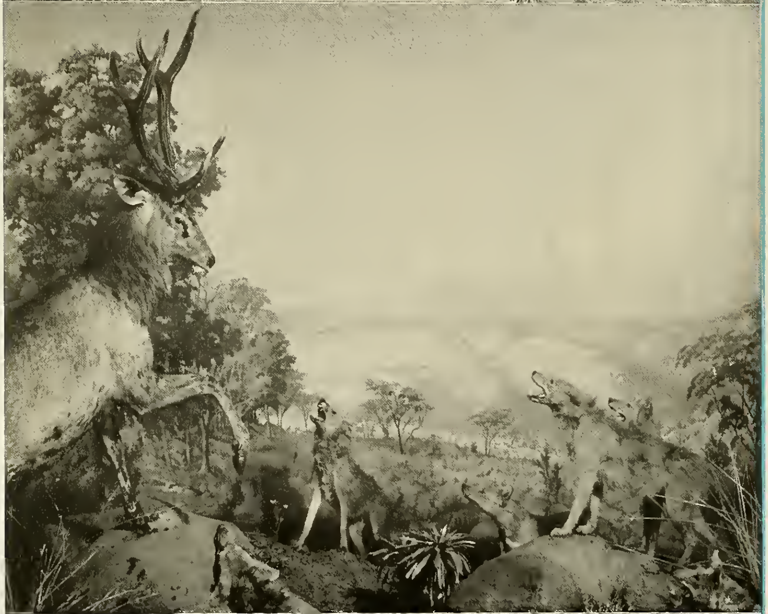
With the present emphasis primarily on Burma, some of the exhibits in the Hall of South Asiatic Mammals may appear too far removed geographically to give useful information, but an over-all impression of South Asia is useful, and as some oriental has said, one picture is worth a thousand words. The visitor, therefore, will do well to note the physical conditions in India, where forces may now be assembled for the invasion of Burma, and to bear in mind that there is considerable similarity in the ecology—the mutual relation between the environment and its life—in areas of the same elevation right across India and Burma.

Thus the exhibit of sambar and barasingha is placed in the Terai (in India) in a swampy terrain. Over these swamps or "jeels" an airplane has fine visibility, and it would be difficult to conceal much from the observer. Outside Myitkyina in Burma, held by the Japanese, there are similar



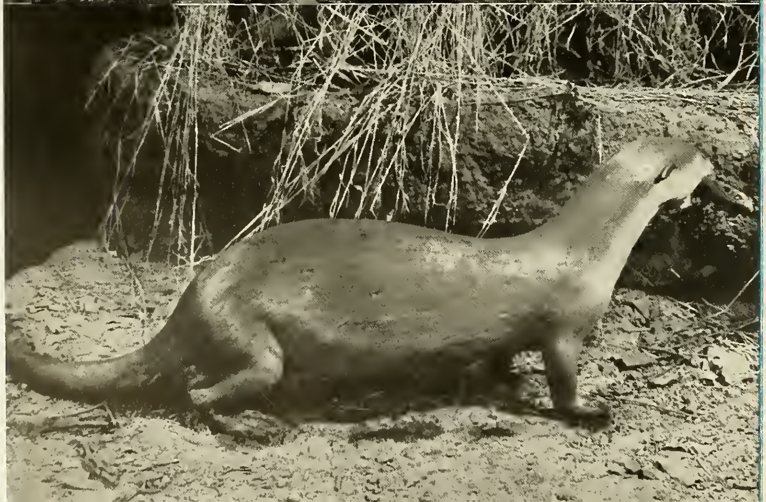
◄ THE GAUR or Indian bison is found in the moist and hilly parts of Burma. It would be a desirable source of food for men detached from supplies. Usually it is not a dangerous animal if unmolested. A wounded gaur is very dangerous, especially if followed into thick cover

► THE LEOPARD is an animal familiar to everyone and a common denizen throughout southern Asia. Here it is usually called a panther, and in the melanistic or black phase it becomes the black panther of literature. Leopards are always dangerous because of their speed. While not likely to molest a man unless attacked, a wounded leopard should be treated with great respect



◄ THE SAMBUR is the largest of the deer to be found in Burma, where it occurs at all elevations. It is a valuable food animal. During the rutting season the males bellow or roar. The wild dogs which are baying at the sambur run in packs and are the scourge of the countryside where they occur

A.M.N.H. photos



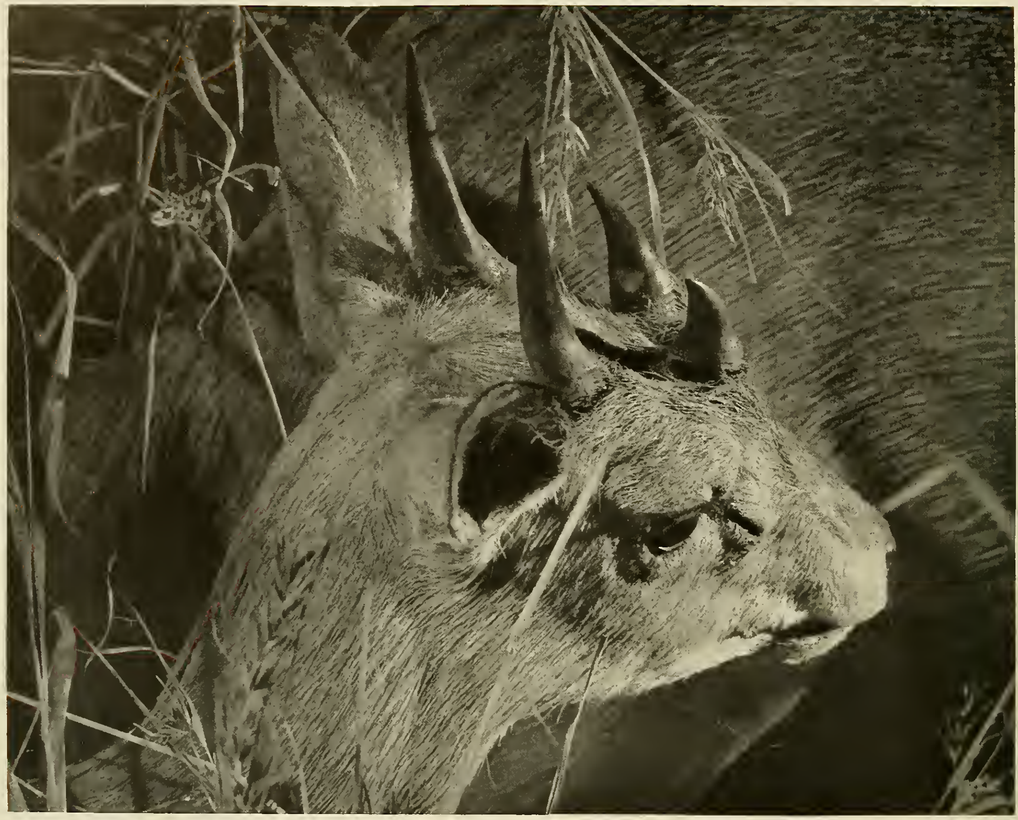
◄ THE OTTER of India and Burma looks very much like our own North American otter and is found along streams. The fish carried by the otter is the mahseer, which attains very large size and is an active fighter on hook and line. It is not highly regarded as food. Along undisturbed rivers one not uncommonly may see one or two otters active by day

jeels and great open stretches to cross. Quite different is the terrain shown in the gibbon group (Burma), where the great forests covering the mountain slopes can hide regiments on a moment's warning. Furthermore, the clouds bank up over the mountains, and a pilot has to watch both sky and earth with a forced landing as a mental hazard.

If the campaign follows the pattern set in the past and the forces move through Akyab and across southern Burma, they will encounter environments which are portrayed in the thamin group (open scrub), in the banting group (bamboo and teak forest), and in the leopard group (heavily forested ravines, or nullahs). If the personnel enters Burma along the line of the new Burma or Assam Road, the itinerary will cut the valleys higher up and the character of the forest is better represented by the photographs accompanying this article taken on the Vernay-Cutting Burma Expedition. In northeastern Burma the Japanese would have some of the same difficulties of supply facing the United Nations, for this stretch is far removed from Rangoon and ship transport.

North of railhead at Myitkyina (pronounced *Mich-i-ná!*) now held by the Japanese, all travel is by trails which soon enter the mountains. Supplies can go on mules over the best of these trails, and have been so carried back and forth from China for years. Trails cross into Yünnan at not infrequent intervals on north from the railroad crossing out of Lashio. Some of these trails could, in time, be made into a new railroad. Now they are bridle paths and cross innumerable streams which must be bridged. Rains, which come in great violence in this region and turn a river into a swirling flood, or a charge of explosive, can wipe out a bridge in a critical spot and close the trail.

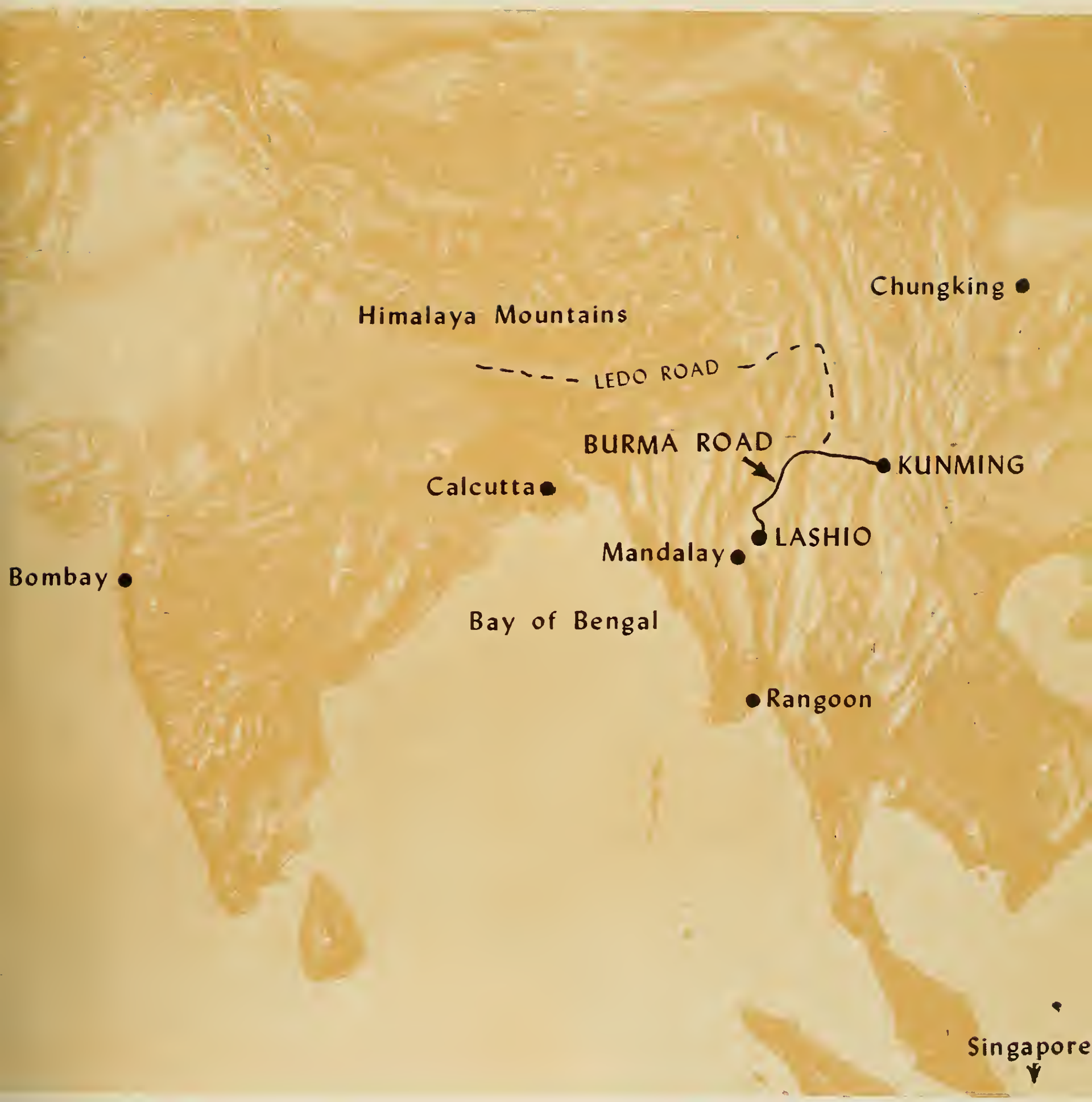
The matter of season is all-important. The dirt-surfaced trail is hard during the dry season, days and nights are comfortable, or reasonably so, leeches are absent, and one can count on fair weather. With the advent of the rains the earth softens, trees fall across the trails, bridges go out, leeches swarm in the grass and shrubbery, everything drips water, and life can be miserable for personnel even without a war.



A.M.N.H. photos

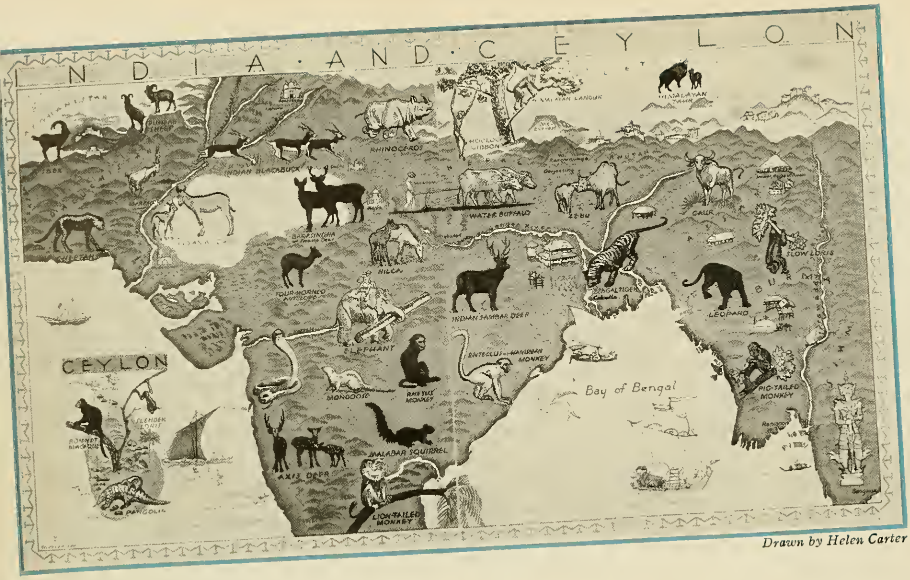
▲ THE FOUR-HORNED ANTELOPE, the only living wild mammal to possess four horns, is one of the smaller ungulates of India and Burma. It is of interest chiefly because of the four horns. But it is limited in its distribution and not likely to come into the lives of the soldiers. Other small ungulates with a wider distribution and more often used for food will be of greater importance in the field of operations. Among these animals is the barking deer or muntjac, a small deer which utters a call aptly described as a bark. These deer have a wide range and are of considerable importance as food

➤ IT has become customary to think of the lion as entirely African in its distribution and to overlook the fact that it is a part of the native Asiatic fauna. Formerly the Asiatic lion ranged through Persia into southern India. Today it occurs only in very restricted numbers in a small part of western India. The Asiatic lion is reputed to have a shorter mane than his African brother, but this is by no mean a reliable criterion and the two are practically identical


Chungking
Himalaya Mountains
LEDO ROAD
BURMA ROAD
KUNMING
Calcutta
LASHIO
Mandalay
Bombay
Bay of Bengal
Rangoon
Singapore

SOUTHERN ASIA

▲ THE RELIEF MAP shows that in Burma the mountain ranges have a predominant north and south direction. All travel from west to east must climb one slope after another, and after each descent a river must be crossed. With heavy rainfall these rivers become very real problems. Even during the dry season melting snows in the higher regions provide enough water to make the principal rivers substantial streams. The elevation of the mountains in Burma increases in general as one goes northward, where eventually the culmination of the uplift occurs in the Himalayas. These facts well illustrate the importance of the existing railroad from Mandalay through Lashio into Yünnan. In this case the travel from the sea at Rangoon is, for the most part, along the north and south valleys. Any new road from India has much more difficult topography to conquer. Not only is it an engineer's nightmare to construct, but maintenance is a constant problem

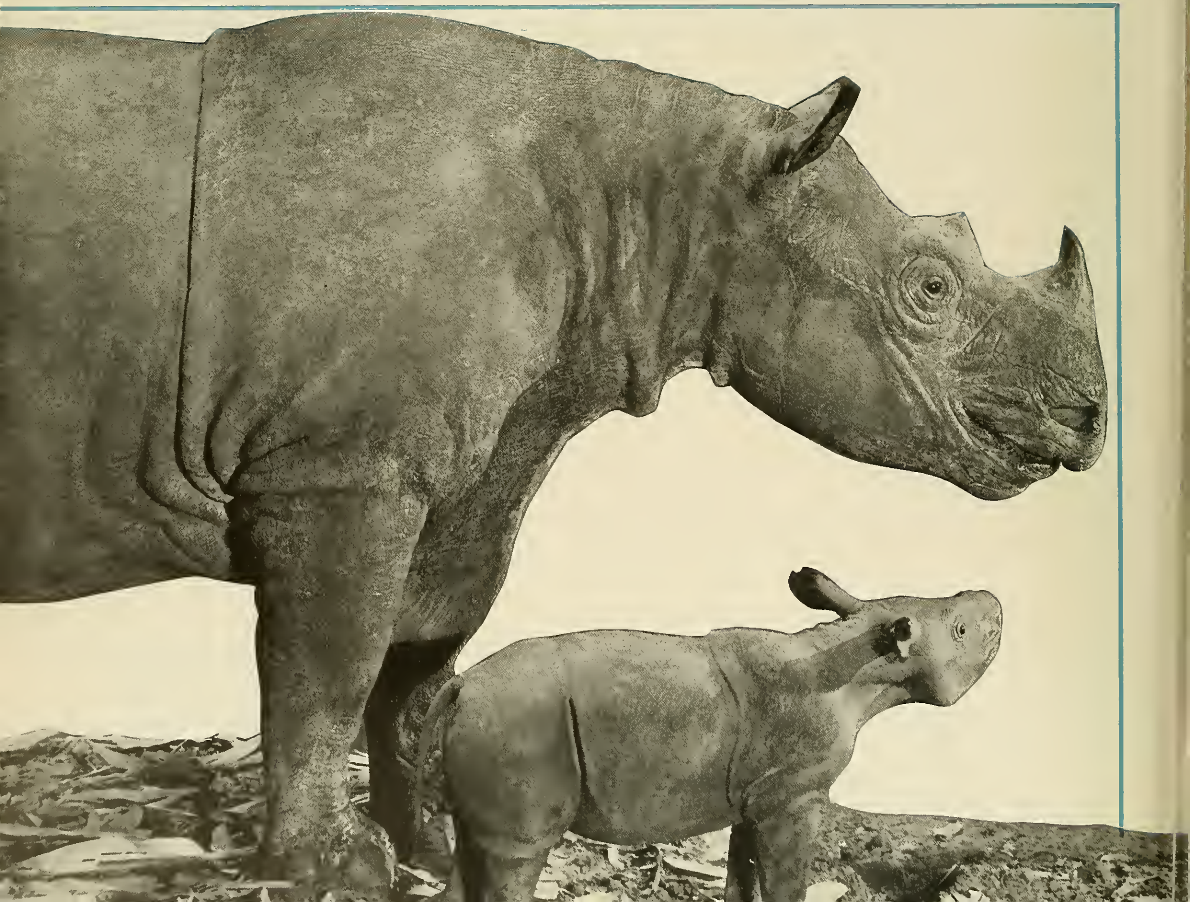

INDIA · AND · CEYLON
AFGHANISTAN
PUNJAB SHEEP
IBEX
RHINOCEROS
HOOLOCK GIBBON
MALAYAN LANGUR
HIMALAYAN TAHR
INDIAN BLACKBUCK
CHEETAH
BARASINGHA
WATER BUFFALO
ZEBU
GAUR
NILGAI
FOUR-HORNED ANTELOPE
INDIAN SAMBAR DEER
BENGAL TIGER
Calcutta
SLOW LORIS
LEOPARD
BURMA
ELEPHANT
ENTELLUS or HANUMAN MONKEY
CEYLON
RHESUS MONKEY
MONGOOSE
Bay of Bengal
PIG-TAILED MONKEY
Rangoon
SLENDER LORIS
BONNET MACAQUE
MALABAR SQUIRREL
AXIS DEER
PANGOLIN
LION-TAILED MONKEY

Drawn by Helen Carter

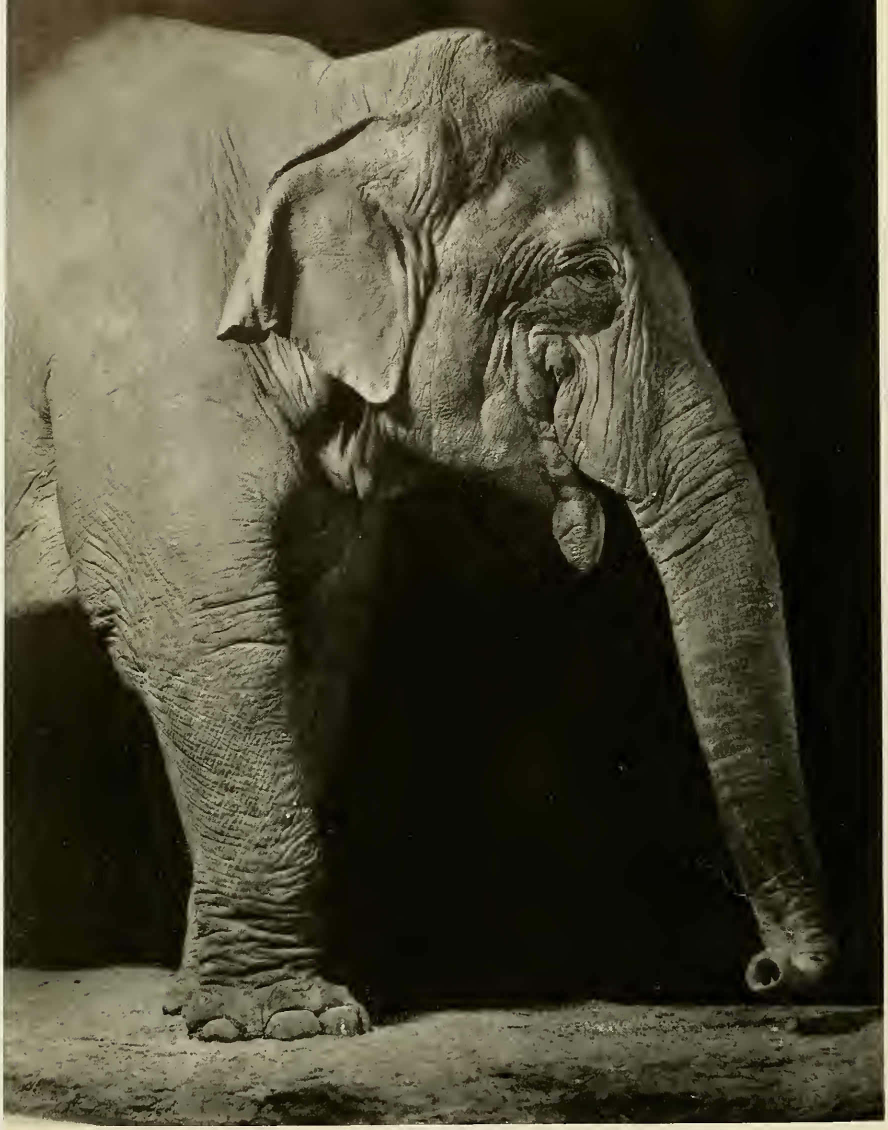
◄ THIS ZOOLOGICAL MAP locates some of the most interesting animals of southern Asia. Many of these have extensive ranges and are found not only where they are spotted on the map but over most of the entire area. In general, the most obvious barrier to distribution is altitude. Animals of the high mountains do not range down to sea level, and vice versa. Most of the animals with oriental affinities are confined to lower elevations; those with northern relationships live in the mountains

A.M.N.H. photos

▼ THE ASIATIC TWO-HORNED RHINOCEROS, sometimes called the Sumatran rhinoceros, is a much smaller animal than either of the two African rhinos or the single-horned Indian rhino. It has become so scarce that the likelihood of seeing one in the wild state is rather small. It is nowhere common in Burma and is confined to the remote and difficult sections. This rhino is not aggressive, and because of its greatly reduced numbers it is to be hoped that there will be no needless killing of the few that are left



▲ THE WATER BUFFALO is common throughout all of southern Asia. It is used as a beast of burden, and wild buffalo still exist in some of the undisturbed environments. It is doubtful if wild buffalo exist in Burma today. This animal takes its name from the fact that it is fond of rivers and marshy areas. The water buffalo is always a dangerous animal. Even the domestic buffalo dislikes the odor of white men and may charge without provocation. A white man should not expect the "tame" water buffalo to act like a range steer. Domesticated or wild, they should be treated with a great deal of respect

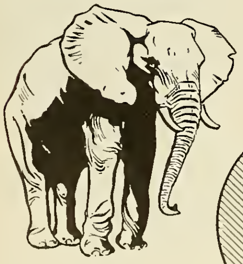


◀ THE INDIAN ELEPHANT, like the water buffalo, is seen both as a domesticated and a wild animal. The tame elephants are worked in the Burma teak forests just as they were when Kipling wrote about them. Wild elephants are found throughout Burma, where they range from the high hills down to the larger streams

↘ THE SLOTH BEAR is not much to look at as compared with the big bears of North America. Although he is no giant, his disposition is very surly and he has the reputation of being a very dangerous animal to cross. Hunters have been mauled and even killed by encounters with the sloth bear

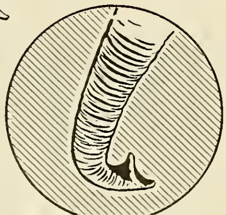
HOW TO TELL THEM APART

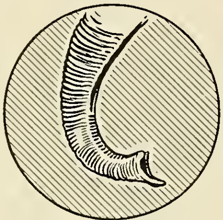
AFRICAN ELEPHANT



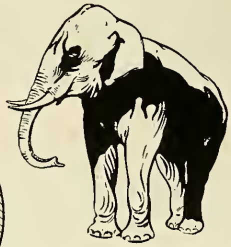
AFRICAN ELEPHANT—large ears, head not "domed," tip of trunk with two finger-like processes. Asiatic elephant—small ears, head "domed," tip of trunk with one finger-like process

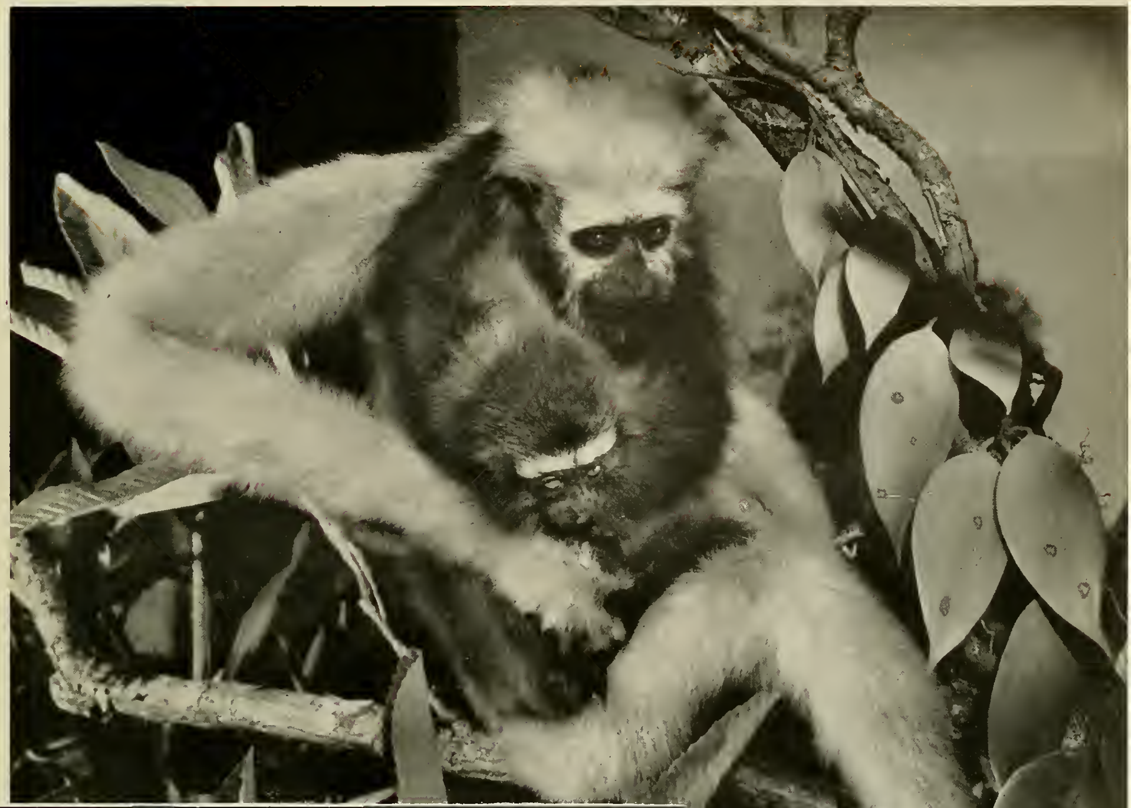
Drawings by Paula Hutchison





ASIATIC ELEPHANT





▲ Gibbons travel in bands in the forests of Burma, calling out at joyous sunrise and making the woods rollick with whoops which may be heard for several miles. The gibbons are classified with the anthropoids or manlike apes in their physical and mental development. In intelligence they stand high on the primate list. Their bands usually show animals of two colors, the blacks being male and the browns female. This animal has a rather wide range in altitude, occurring in forests from the lower elevations up almost to the snow line. It is one of the most interesting of the wild creatures one may expect to see in Burma and is the master gymnast of the jungle

UP FROM THE DEPTHS

As man soars ever higher and airlanes are charted through the mysterious stratosphere, the man in the street may soon travel through a realm completely unknown a few years ago. What does it contain?

By HOBART E. STOCKING

SCIENTISTS at sea sometimes dredge up odd creatures which newspapers immediately headline as "denizens of the deep." In reading such accounts we seldom give thought to the fact that we ourselves are denizens of a vastly greater "deep"—the very lowest depths of the Ocean of Atmosphere.

The daring young man on the flying trapeze flew with lyrical ease through a mixture of 78% Nitrogen, 21% Oxygen, and a minor amount of rarer gases. It is only in recent decades that meteorologists, "scientists of things above," have extended the limit of their knowledge beyond the turbulence resulting from human activities. An abundance of curious information has come from travelers rising from the earth—from planes climbing to around 10 miles, manned balloons 13 miles, sounding balloons 21 miles, and free-floating balloons 23 miles. To the earthbound these distances seem considerable, but the highest balloon rose only 1/30 of the distance to the apparent surface of the gaseous envelope surrounding the earth. It provided valuable information concerning less than 1/180 of the atmosphere. For knowledge of the remaining 900 billion cubic miles meteorologists must rely on messengers from outer space.

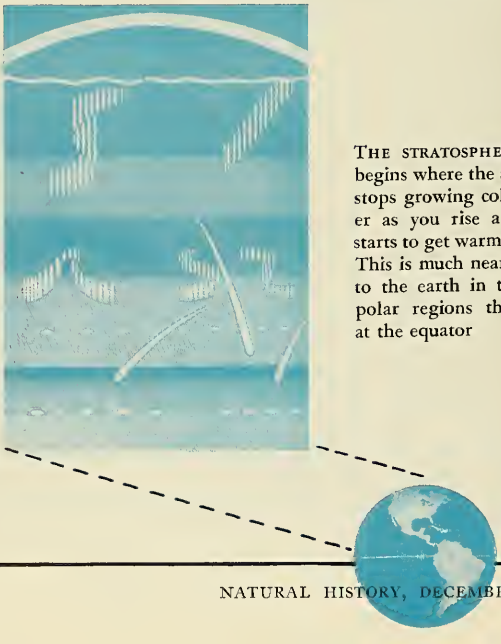
From out of nowhere into here comes static to annoy us, interstellar dust to enlarge the earth, infrared and ultraviolet radiations to burn or bless; cosmic rays to shatter atoms and perhaps cause mutations; meteors to intrigue and terrify; long and short radio waves to distract or entertain; light and heat to comfort or torment; reverberations from a troubled world and, of course, the Martians of Orson Welles. Meteorologists interview each of these inanimate voyagers and from them extract the last drop of information concerning the Ocean of Atmosphere they have traversed. The news they gain, like the material it concerns, is less substantial with distance from the earth. All knowledge ends at the highest aurora, 700 miles up.

The atmospheric layer in which mankind lives is the zone of biologic and meteorologic unrest. Over the biological struggle for survival, meteorological storms surge, heat waves envelop continents, and blizzards paralyze commerce. This turbulent layer, the Troposphere, is constantly agitated by irregular vertical and horizontal air currents; and on these movements depend the uncertainties of the weather. It is also the zone of light and warmth. Sunlight passing through clean air leaves it unwarmed and invisible. It is the reflection of light from the earth and from the dust in the atmosphere that brightens our days, and it is the heat radiated from the earth that warms the air about us.

Since air is warmed chiefly by reflection and radiation of solar heat from the earth, an aircraft pilot, as he rises to greater altitude, encounters air of constantly lower temperature. Balloons that have mounted high above the earth and returned with a report of their travel recorded by automatic instruments, have provided proof that about eleven miles up from the equator the temperature falls to 112° below zero Fahrenheit. But from that elevation, each additional mile of altitude shows a rise, not a fall, in temperature. In polar regions, the same balloon would rise only four miles from the earth to encounter the level above which the air temperature does not change perceptibly with increasing height. At this altitude the temperature is about minus 58° Fahrenheit, although below this level the temperature in the Troposphere may be either greater or less in various localities.*

The temperature reversal occurring at an elevation of eleven miles above the equator and four miles above the poles presents an odd paradox in relation to temperature differences nearer the earth. It means that at the same level in both regions, for example 12 miles from the earth, the air is warmer over the North and South poles than it is over the equator.

This plane of temperature reversal separating the Troposphere from the Stratosphere is known to the meteorologists as the Tropopause. The Troposphere is a zone of storms characterized by uncertainty in their intensity, speed, and direction of move-



THE STRATOSPHERE begins where the air stops growing colder as you rise and starts to get warmer. This is much nearer to the earth in the polar regions than at the equator ment. These disturbances are hazards for aircraft attempting to fly on certain schedules. Although the Stratosphere is by no means a realm of peace, it is above the level of sudden and uncertain storms. The strong winds within it are persistent in direction and force and are easier to reckon with in calculations for airborne commerce. From San Francisco, the shortest route to European ports lies over polar regions. The traveler of the future will rise above the level of storms and in perfect comfort look down on the point that Admiral Peary achieved only after years of labor. If the passenger is bound for Cape Town, he will probably transfer at, say, Moscow to a ship of different design, because a journey through the Stratosphere over the Tropics requires flying at higher altitudes.

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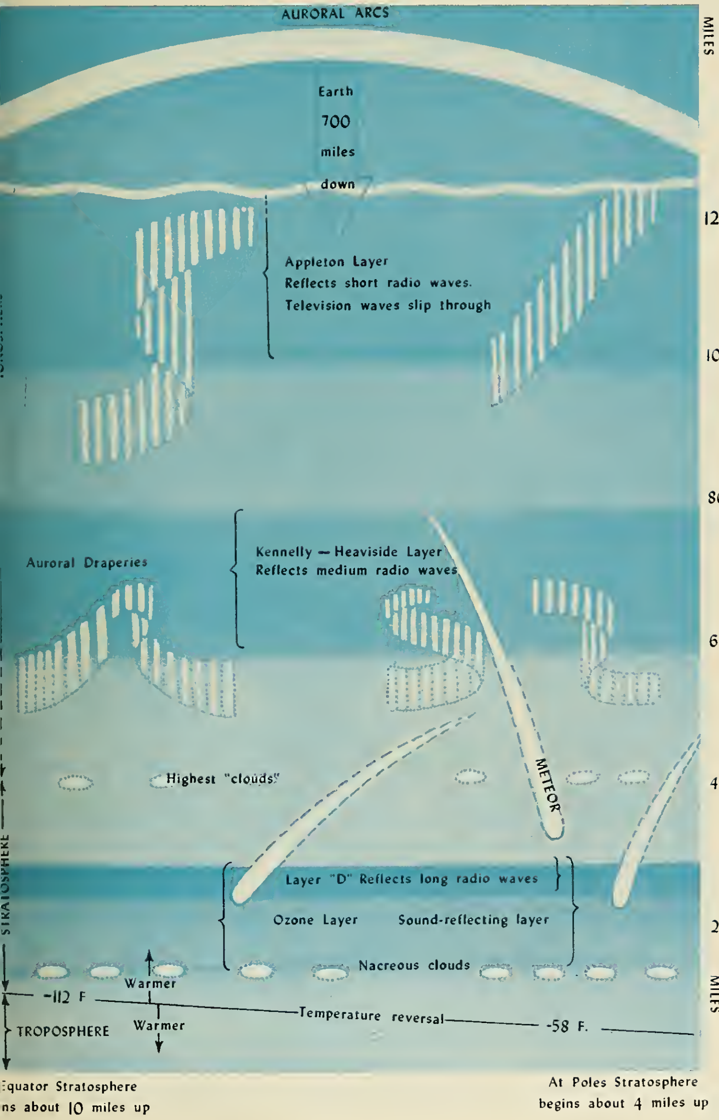
*Near the earth in the Arctic in winter the temperature frequently gets warmer instead of colder with altitude. Sometimes it will rise from −50° F. to −10° F. in the first 500 or 1500 feet. Flyers take advantage of this.

In 1932 Professor Piccard, the well-known physicist, peering from a window of his enclosed aluminum gondola 53,000 feet from the earth, saw deep-blue, almost black space above. Through the Stratosphere about the balloon passed rays from the sun to warm and illuminate the earth, but the surrounding air was dark and cold. Through special earphones he heard the patter of cosmic rays striking the metal sphere, a sound like that of rain on a tin roof. Below Professor Piccard lay only 1/70 of the thickness of the atmosphere but more than ¾ of its weight, for at this altitude the air had become exceedingly thin. The dense air below screened the earth from cosmic rays as effectively as a foot of lead might have done, protecting life on it from the full intensity of a barrage which might well be fatal through a less effective screen. These rays, which emanate from the sun, can batter atoms apart. Biologists have used X-rays and radium emanations to alter genes in chromosomes and thereby produce mutations—changes in the structure of the organism, which (if not lethal) are passed on intact to subsequent generations. It has been suggested that a similar effect by cosmic rays may have played a part in the evolution which resulted in the human race. Geologists have presented evidence which has been interpreted by some as indicating that the atmosphere of past ages was not identical with that we now breathe. It may have been a less effective screen against cosmic rays.

▼ Diagrammatic cross-section of the atmosphere shows three main layers: Troposphere, Stratosphere, and Ionosphere. The existence of other layers at various heights is detected chiefly by the behavior of radio waves, meteors, auroral displays, etc. Man has only begun to explore the Ocean of Atmosphere under which he lives


AURORAL ARCS
MILES
Earth
700
miles
down
120
Appleton Layer
Reflects short radio waves.
Television waves slip through
100
80
Kennelly — Heaviside Layer
Reflects medium radio waves
Auroral Draperies
60
Highest "clouds"
METEOR
40
Layer "D" Reflects long radio waves
Ozone Layer
Sound-reflecting layer
20
Nacreous clouds
MILES
Warmer
-112 F
Temperature reversal
-58 F.
TROPOSPHERE
Warmer
STRATOSPHERE
quator Stratosphere
ns about 10 miles up
At Poles Stratosphere
begins about 4 miles up

The bellow of chaos, the roar of battle, deafening noises from a troubled world speed outward and upward, a mile in five seconds. Sound waves mount into the Stratosphere leaving for an instant, soundless devastation behind. Miraculously the sound reappears, muted by distance, now but an echo of its former magnitude—an echo reflected from a dense layer of warm air far above the earth.

In the last war, Flanders' guns were frequently audible at Dover when they were not heard at points closer to the battle front, for the angle of reflection of their roar from great height brought the sound to earth again far from the flash of the cannons.

The speed of sound through air of varying temperatures is known from laboratory experiments. The time-interval between a sound and its echo is a yardstick by which the height of the sound-reflecting layer has been measured. It has been found to extend from 15 to 30 miles above the earth. At the surface of the earth, sound may be reflected by any substance that is more dense than the air transmitting the sound—by a mountainside, a cliff, or even a fog bank. In the Stratosphere sound is reflected to earth by a layer believed to be ozone, a gas heavier than air. The faint, chlorine-like pungency which pervades the air after a vicious, near-by snap of lightning is the smell of ozone. In the Stratosphere, ozone is the result of the action of ultraviolet rays from the sun on atmospheric oxygen. Ozone is formed only at a height where the density of the atmosphere, and its screening power, is slight and where rays from the sun are of sufficient intensity.

The ozone sound-reflecting layer has the property of absorbing considerable heat from the sun, and its temperature is calculated to be 120° Fahrenheit, about that of an afternoon in Death Valley. No one has been so high to measure such heat, but there are means other than personal contact.

In its orbit around the sun, and with the sun through the galactic system, the earth constantly passes through new space. Enroute to nowhere, the earth sweeps up cosmic debris along its path. In addition to the countless tons of dust Mother Earth sweeps from space every day there is an occasional meteor, traveling at from 10 to 60 miles a second. As long as meteors speed through the nearly frictionless realm of interstellar space, they remain as dark and as frigid as their environment. When they strike the Ocean of Atmosphere and plunge downward, they push aside molecules of gas. Quickly they penetrate to lower and denser levels, and the air-cap which they push before them is heated by compression. This heat, imparted to the meteor, sets it glowing. Around 30 miles up, meteors suddenly increase in brilliance and thereafter leave a glowing train of incandescent vapor. Devious calculations concerning speed, brilliance, and duration of meteor trains furnish a clue to the temperature of the ozone or sound-reflecting layer.

Glowing meteor trains have been observed as high as 60 miles, and there they have been charted in a lateral drift of a hundred miles an hour—certain evidence of air currents of that velocity high above the earth. So great is the speed of meteors and so intense the heat of pressure generated by the speed of their passage, that only one in 20 million strikes solid earth. The remainder vanish high in the sky as their solid substance is converted into vapor. Countless tons of meteoric vapor, deprived of heat by reduced velocity, condense to minute solid particles, which settle gently to the floor of the Ocean of Atmosphere. Slowly but constantly they add to the size of the earth.

The Stratosphere, according to meteorologists, ends about 50 miles up, and at this level float the highest clouds, faint and feathery. They are so removed that they are familiar only to scientists of the skies. From here on stretches the vast Ionosphere. On variations in the nature of this uppermost known layer of the Ocean of Atmosphere depend the vagaries of radio transmission. If your favorite symphony or "soap-opera" fades annoyingly, it may not help to call the repairman, for some difficulties lie beyond his reach. The ultimate cause lies in the sun, and the immediate cause of your annoyance may be one of the three reflecting layers of the atmosphere.

Layer "D," between 25 and 30 miles up, near the top of the ozone layer, has the property of reflecting long radio waves. The Kennelly-Heaviside Layer, in the Ionosphere, 60 to 80 miles up, reflects medium-length radio waves. The voices of Hollywood entertainers bounce off this layer several times before they reach New York. Short-wave broadcasts from England reach American shores by reflection downward from the Appleton Layer, the base of which is about 100 miles from the earth.

The exact nature of these layers is uncertain, but they are the result of the action of sun rays on the gas of the atmosphere. Everyone is familiar with the general rule of radio reception—best at night and in winter. It is known that the layers rise higher as the sun goes down and that they are higher in winter than in summer. Physicists, for reasons best known to themselves, have suggested a temperature of 1600° Fahrenheit for the Appleton Layer, the highest and densest of the three. Your kitchen range would be a glowing liquid at considerably lower heat. Whatever the specific character of these layers, it is known that the shorter the wave length of radio transmission, the more dense must be the layer that reflects them. Television waves, much shorter than short-wave radio, are so minute that they slip through the Appleton Layer, presumably to wander in cold outer space. For this reason television transmission past a mountain range or over the bulge of a round earth is not yet possible.

From the gigantic power station that is the sun comes light to cheer mankind and warmth to comfort him. From the sun also comes a constant stream of electrified particles to produce the astonishing display of Northern and Southern Lights. The earth is a colossal magnet and, like the familiar horseshoe magnet of the laboratory, the earth has a north and a south magnetic pole. Neither of these coincides with the geographic poles. Just as the laboratory magnet will attract iron filings, so does the earth attract to its magnetic poles the electrified particles from the sun. As these particles or charges collide with gas molecules in the thin upper atmosphere, the latter are caused to glow. This glow is the spectacular Aurora Borealis of the Northern Hemisphere, matched only by the splendor of the Aurora Australis of the southern half of the earth. During a period of sunspots, electrical discharge from the sun is at its greatest intensity, and at such a time Northern Lights have been seen even at Singapore, almost on the equator.

The height of Auroral displays can be calculated, and this distance serves as yet another yardstick for measuring the depth of the Ocean of Atmosphere. Such spectacles cannot take place without the presence of air, however thin and different it may be from that we breathe. The lowest streamers and curtains of the Aurora ripple within 50 miles of the earth. The highest, the Auroral Arcs, have been charted 700 miles from the earth. These celestial curtains vary in color from white to red and green, and from these vibrant shades science derives yet another drop of information. Spectroscopic analysis of Auroral colors shows that nitrogen and ozone are present even 700 miles from the earth, and the bright red of lower curtains undulating only 50 miles away reveals the presence of oxygen.

A bright scarlet curtain which waved over England shortly after the death of Thomas à Becket, was recorded in folklore as the blood of that martyr ascending to Heaven. To the Norse, the brilliant curtains which flicker and undulate in the perfect peace of a clear, cold night are the Valkyries choosing heroes worthy of passage to Valhalla.

Ways of the Woodchuck

➤THE ODD LITTLE OLD MAN of the woods who is supposed to foretell the weather once a year will retreat from even less than his own shadow—as you will admit if you have tried to devise a method of capturing him

A.M.N.H. photo

Know him better and you will find that even so familiar an animal as the common ground hog is a fascinating subject for nature study

By RICHARD F. TRUMP

Most anyone knows how to catch a ground hog. You just chase him up a tree and go up after him. Or you hold a noose at the entrance of his den and snare him on the way out. You pad the jaws of a steel trap or make a figure-four trigger on an old nail keg. He'll blunder into any sort of trap. Or, when he's out in the middle of the bean field, you chase him down with a butterfly net.

That's the sort of advice I was given whenever one of my outdoor friends learned that I wanted woodchucks. It was good advice.

My intent had been to capture and tag the animals in order to study their movements and territorial behavior. But long before I managed to clamp the first tag into one of those tough ears, I learned a few things about ground hogs—namely that it is no simple job to chase one up a tree, slip a noose over one's neck, or in fact to catch one alive by any means.

However, I still say that it was good advice. For it was largely through my fruitless attempts to capture them that I began to understand why these rodents have prospered so well during the period since white men began to remake this continent.

One dewy morning early in July, I watched from a thicket while a grizzly looking woodchuck came out of a den and sat up, motionless as a hickory stump, inspecting its feeding territory. After about three minutes the rodent turned its head quickly to the left. Again it remained motionless. Then back to the right. After ten minutes it dropped to all fours, moved quickly forward a few feet, and repeated the freezing performance. In each position it looked as if it might have been planted there by a taxidermist!

Passing a hollow shagbark log, it advanced into the clearing and nibbled clover leaves. At intervals it would suddenly sit up and scan the edges of the clearing. I swatted mosquitoes and waited.

After about a quarter of an hour it sat up with apparent alarm, looked about, and then for no visible reason ran toward the den. At the hollow hickory log it stopped and crouched quietly for fully five minutes. As if satisfied that an unseen danger had passed, it then climbed atop the log and dozed in the morning sunlight that filtered through the white oaks bordering the clearing.

If that chuck had gone inside the hollow log, he would have stepped on a wooden trigger, releasing a door that would have fallen over the entrance to cut off his retreat. He would have found the other end of the log barred by a heavy screen. . . . The woodchuck dozed in the sun. I swatted mosquitoes.

During the preceding weeks I had constructed roomy traps of both wood and metal, baiting them with a menu that should have taken in the most discriminating vegetarian. But the vegetarians nibbled their wild lettuce and legumes where they grew. I had blocked all but one of the entrances of a den and connected the one remaining opening by a screen funnel to a trap. The occupant dug a new exit. And I had crept along the creek and raced into the clearing with a strong net, hoping to bag a chuck before it could reach cover. But the sound of man sent it lumbering to safety ahead of my net.

Others, too, eluded me. But in the course of my prowlings I noticed that almost without exception a ground hog on its way home followed a definite and well-worn path. This was frequently true even when the animal was being chased and had to detour in order to follow its runway.

Perhaps this observation initiated my first successes. For on July 18 a young three-pounder wandered too far from its home den, and as I closed in with my net it charged into a dense growth of dogwood and grape. Since there was no den in that particular

◀**ALTHOUGH** recognized as one of the most ferocious fighters of his weight, the woodchuck does more than his part to avoid a clash. For protection he depends heavily on the good earth

▼**IN ORDER TO STUDY** the movements of woodchucks it was necessary to tag them with numbers. The author learned that although this animal is not a fast runner, he is a very credible dodger

thicket, the chuck now has the distinction of wearing tag number 1379 in its right ear.

In convenient succession another woodchuck tried to hide in a shallow emergency den in a clover field, and a spade teased it out into a sack. Still another made the mistake of stepping on the trigger of a big basket-like beaver trap, which the Iowa Conservation Commission had offered to help the cause along.

And on July 24 I entered the following notes in my field book:

"Hottest day we've had. While eating supper near the river at Ely's Ford, we saw a large mammal on the little island some 100 feet offshore. It walked down to the water and waded in. When I stood up for a better view with the glasses, it stopped, apparently frightened. It was a woodchuck.

"Lorene went down to the water's edge to keep it from crossing while I took my net and waded the channel at a narrow point a short distance below.

"Approaching then from the rear I could see that the mammal was nearly submerged. No trouble slipping the net over it, but the rascal immediately lunged forward, ripping through the wet netting. I tried to entangle it in the cloth, but it tore out again. In desperation I grabbed it by the tail, keeping the net in a position that occupied the fighter's teeth. In the meantime Lorene came to meet me with a burlap sack, and the chuck is now in the bag!"

It weighed eight and a quarter pounds. For the release next morning we took the swimmer back to its island. Tagged and released, it hurried into the water without hesitation and swam for the other shore. I followed, wading knee-deep, and snapped a picture. It took the landlubber 55 seconds to make the crossing—a distance which I calculated by triangulation to be about 40 yards.

A lucky coincidence enabled me to compare this rate with that of a more truly aquatic rodent, the muskrat. When I had first returned to the island, one raced out of the swamp smartweed, dived in, and swam across *under the surface* in 32 seconds. Although its path was slightly downstream, the greater distance probably more than offset the help of the weak current.

As the summer progressed I baited traps with a soapy smelling lure that was concocted by a commercial concern. Several chucks entered, and were duly weighed, tagged, and checked for external parasites. I hastily recorded in my notes that the lure was the thing!

The nights grew longer, the woodchucks fatter; and on November 27 I entered my last record of a wide-awake chuck for 1940.

The next spring, as soon as I could put aside microscopes, charts, and grade books, I was back in the field with my precious bottle of lure and a dozen new traps constructed of 19-gauge hardware cloth, half-inch mesh.

The woodchucks entered. But a disturbing number of them left again by way of gaping holes torn in the sides of the traps. Some of the captives ineffectually scattered their efforts over several points on the walls of the traps, therefore remaining inside. But others ripped at the same soldered joints until they were able to leave for more comfortable quarters.

While mending the damaged traps and constructing new ones of a heavier, welded material, I found that if the captives were provided with strips of wood along the inner sides of the trap, they apparently were satisfied to gnaw on the wood instead of the wire! A darkened nest compartment to which the chuck could retreat also helped to prevent repair bills.

In the meantime, in order to obtain real proof of the value of that soapy lure, I made a number of sets with new and unbaited traps. The result: I tossed the lure aside, concluding that if a good trap is properly placed, nothing more is needed.

Although woodchucks do the greater part of their feeding in broad daylight—a few hours after sunrise and again before dusk—they have that almost universal rodent-fondness for retirement in dark places. Once they are inside a cage, it is hard to get them out. Even in the exposed wire traps they seem to feel a certain security, for when the door is opened in sight of their dens they often refuse to budge. Although they will generally run into a burlap sack held over the opening, at times I have had to turn the trap down and shake it vigorously to dislodge the captive.

Once when I released a woodchuck near the road it ran under my car. Wanting to observe its behavior in strange territory, I tried to frighten the animal into the open. It refused to go. I then drove forward several yards, and got out to find that the woodchuck had followed beneath the car!

On another occasion I turned one out on a wooded hillside near a boys' camp; it ran inside one of their tents and took refuge under a cot. A half dozen yelling boys succeeded in driving the frightened rodent into the open, and it found greater security in a hole down the ravine.

One of the woodchuck's chief secrets of success is its habit, as Teddy Roosevelt would have said, of speaking softly and carrying a big stick. For while it is recognized as one of the toughest and most ferocious fighters of its weight, the woodchuck does more than its part to avoid a clash.

Woodchucks seldom spend more than a few minutes feeding without sitting up to inspect the territory. One mature specimen which I clocked during 79 alternating periods of feeding and watching spent over 32 percent of its time sitting up; the intervals of feeding averaged less than seven seconds each. Another specimen, observed on the same day, spent less than 14 per cent of its time watching, and averaged 64 seconds for each feeding interval. Incidentally, we speak of woodchucks and other plantigrade or "flat-footed" animals as "sitting up" when frequently they are standing, supported only by the feet. I once saw a woodchuck rise to full height, standing on its hind toes as a digitigrade mammal (a "toe-walker") would do when erect. However, this is apparently not a common posture.

When danger appears imminent, the woodchuck either dashes to its den or drops to the ground and freezes, its head flattened against the earth. Only on a few occasions have I seen a chuck

▲AFTER MANY METHODS were tried, the secret of catching woodchucks was discovered. The animal *could* go around, but with a trap set directly in a well-worn runway, he seemed to find it less bothersome to go inside

➤THE YOUNG are perhaps too trusting and curious for their own good. This one came out while the author stood nearly straddling the entrance to the den. It was caught with a net and now wears a numbered "earring"

Photographs by the author

GROUND HOG MOTHERS have been accused even of pushing their offspring out of the hole to distract the attention of a dangerous dog. But close observation of their psychology gives the author a feeling that a primitive sort of mother love must have helped to make the ground hog successful on earth

Photographs by the author

THE WOODCHUCK is a landlubber, but
one swam across a 40-yard stream at ab
two miles per hour — only 20% slo
than a muskrat swimming under wa

more than a few seconds from a den. One such case was that of the swimmer, which had no den on the island where it was caught. Another was a young female that I caught with a net while it fed in a small clover patch. Having mapped all dens in the vicinity, I was sure there were no holes near; and when it was released the chuck ran across a field of young pines 148 yards to a den along the river.

In connection with their habit of feeding near home, it is interesting to note that their rate of travel is relatively slow. I have timed a number of the animals with a stop watch or by counting after they were released from the tagging cage. Of those which really ran, the slowest traveled about four and a half miles per hour, the fastest, a mature twelve-pound male, eleven miles per hour. These rates were of course over rather short distances, from 30 to 75 yards.

Associated also with their slowness and reliance on shelter rather than fight is the fact that woodchucks frequently construct short emergency dens in the clearings where they feed. A typical emergency den was involved in an experience recorded June 30:

". . . There were two entrances, six feet apart, and by poking with a stick we could chase the animal toward one entrance, then the other. By digging into the middle of the den we confined the ground hog to a rather short tunnel. While Wiley engaged it from one entrance, I grabbed its tail from the other. But though I pulled so hard I was afraid of removing the tail tissue from the vertebrae, it would not give way. Wiley grasped its hind legs and pulled at the same time, but the rodent seemed a part of the earth. Then Wiley dug toward its head. It snapped at the spade once and backed enough so that I was able to pull it from the burrow into the net."

Such dens are quite different from the deep burrows among roots and rocks where the chucks rear their young and hibernate. The real woodchuck homes commonly extend four feet below the surface and have passageways totaling up to nearly 50 feet. Of the several entrances which generally go with each den, one is frequently a "plunge hole," dug up from below and therefore lacking the mound of soil typically found at the other entrances.

While trying to catch chucks with a net, I have sometimes been fooled when the rodent dropped into an unseen entrance some distance from the others. Perhaps the woodchuck's chief predatory enemy, the red fox, has had similar disappointments.

Certainly the woodchuck relies heavily on familiarity with its own territory. Released outside their regular home range they may blunder into a convenient den, but sometimes they behave as number 1377 did, which ran past a den, actually stepping on the edge of the mound, without entering. While woodchucks may show some reluctance to enter dens inhabited by other chucks, numerous observations show that they actually do so—sometimes to be promptly chased out again!

The behavior of woodchucks released at varying distances from the point of capture has aided in determining their home range. Suppose a tagged animal, captured originally at den A, runs directly through high clover to den B, is caught a few days later at C, and takes refuge in den D —then it appears that the woodchuck is familiar with the territory bounded by these points. If circumstances leave any doubt as to whether the chuck is entering a familiar den, as opposed to merely finding a den by means of sight or odor, then the observation has no value. However, several of the animals which were released more than a mile from "home" appeared utterly confused, and did not take advantage of good dens only a few yards away.

Occasionally I have released a chuck at a point equidistant between the den where it was captured and another den, taking care not to block its way back to the home den. Several such specimens have run to the second den.

As one might expect of a mammal that is able to den near an abundant source of food and to depend heavily on the good earth for protection, the woodchuck does not normally range

A.M.N.H. photo; by William Nesbit

Woodchucks seldom spend more than a few minutes feeding without sitting up to survey the territory

far from its home. During July and August of 1941 I was using eight traps along a short course of creek which cut through an alfalfa field. Two of the traps were directly across the creek from each other. During a period of 36 days one chuck entered these two traps four times, twice on each side of the creek. It was not taken in any of the other traps.

Number 9202 was released nine-tenths of a mile from the point of capture, in an area where other woodchuck dens were abundant. Seven days later it was retrapped 20 yards from its home den. And another specimen, tagged August 17, 1941, and released at the point of capture, was taken August 28 of the following year only 135 yards away.

Although not typically a wanderer, the woodchuck does considerable prowling during the mating season. W. J. Hamilton, Jr., reports that the rufescent woodchuck in New York is partially nocturnal during March. In the morning one may find its tracks in fresh snow and observe trails leading from den to den.

Among other poorly supported notions about ground hogs is the idea that they take little if any care of their young. In *American Animals,* Stone and Cram tell of "little woodchucks only a few weeks old, wandering about the field alone and unprotected, having been driven from their homes by their hard-hearted parents as soon as they were able to shift for themselves.

". . . The female has in fact on occasions been said to push her offspring out of the hole one at a time in order to purchase her own safety by distracting the attention of the dog that was digging her out."

The family ways of the woodchuck are still somewhat obscure, and it is always difficult to find the man who really was there "when it happened."

In June, 1942, I had caught a young chuck, about six weeks old, and had set a couple of live-traps near the den, hoping to catch others of the litter. On the evening of June 23 each trap contained another young chuck. As I approached, two other young and one adult took refuge in the den. One of the traps had been moved about two feet, and from teeth marks on the outside of the frame I suspected that the parent had attempted to free the captive.

My notes of June 24 tell the rest of the story:

"To check my notion about the woodchuck I took one of the captives back to the den site this evening inside the wire trap. One of the two young remaining 'at home' was on the grass some 20 feet from the den. Even without a net I had no trouble catching it and putting it into the trap.

"After setting up my camera near the trap and den, and attaching a thread to the shutter, I made a rough blind of box elder branches up the hill about 50 feet. Then I sat on a rock and waited. When the rock got too hard after an hour or so, I went off and looked for rabbit nests.

"Shortly after returning I heard a sharp whistle or squeal—perhaps both —and a big dark-colored woodchuck came from the lower entrance toward the trap.

"As she approached, sniffing toward the trap and jerking her tail vertically, the two captives redoubled their efforts to escape, squealing and scratching. I pulled the thread. Undisturbed by the click of the shutter, she started pushing at one end of the trap. Fearing she would tip it over so the door would fall open, I threw a stone; she ran for the lower entrance, which was among the hackberry roots over the edge of the bank. When she was out of sight, I ran down and turned up the film.

"I was hardly safe in the blind when she came out again, twitching her tail. After scanning the landscape a moment, she approached her young and put her front feet on the trap. I pulled again, and this time she seemed to hear the shutter and started for the den. However, I had to throw a couple of times before she disappeared. I didn't want her to see me leave the blind.

"While I was turning the film this time she came out, saw me, and disappeared again.

"After another short wait, she reappeared over the edge of the bank. There was a quick whistle, and she advanced pumping her tail. This time, however, she entered another of the three entrances, and appeared a few seconds later at the entrance nearest the trap. When she stopped, halfway out, I pulled the thread. She did not move, so after a couple of seconds I pulled again, thinking the extra exposure might be necessary now that the valley was deeply shadowed. Just as she came out and again started to push the trap, she was frightened by an old car rattling down the side road toward us. And since darkness was now coming on rapidly, I took the chucks and left."

Although this woodchuck's behavior was hardly comparable with the parental bravery that one may observe in some other forms of animal life, the experience left me with a curious feeling that a primitive sort of mother love must help, too, in making the ways of the woodchuck successful on the earth.

A stirring saga of exploration is unfolding as botanical scientists discover new plants that can free America from dependence on Asiatic sources for rubber

New Sources o

By HAROLD N. MOLDENKE

NEWSPAPERS the world over have for the past year or more been filled with reports of the tremendous war efforts of our valiant ally, Russia. Everyone knows by now that one of the prime essentials of modern warfare—defensive or offensive—is rubber. Every schoolboy also knows that in spite of her huge expanse of territory, Russia has no region where she can grow *Hevea brasiliensis* or *Castilla elastica*, the world's chief sources of rubber. Before she became embroiled in the present war, Russia imported most of her rubber. Realizing the danger of being thus dependent on outside sources for this vital material, the Soviet Union long ago began experimenting with synthetic rubber and soon turned out vast quantities—in 1937 47,000 tons, or nearly half of that year's total consumption.

Russian synthetic rubber is made from alcohol, distilled chiefly from grains and from the common Irish potato, native to South America. Alcohol-made rubber has serious shortcomings and is expensive. Ten acres of potatoes are needed to make one ton of rubber. Moreover, it lacks sufficient elasticity. For the manufacture of automobile tires and tubes, for instance, about 15 per cent of natural rubber must be added.

Aware of the great desirability of finding some native Russian vegetable source of latex from which rubber could be made, the Soviet Government appealed to its botanists—scientists whose worth to a nation is so often unappreciated until some crisis like a great pestilence, famine, or war arrives! Thirty botanical expeditions were organized, handsomely equipped, and ordered to re-study Russia's entire flora in the search for a native rubber-bearer. In three years the scientists had covered the country from its Pacific shores at Vladivostok and Sakhalin, southwest to the Crimea, and north to the Arctic Circle. Over 100,000 kinds of plants were examined, of which 4925 were carefully analyzed and tested. A number were found to contain rubber in very small quantities.

One of the botanical expeditions was led by the Soviet botanist, Dr.

▼ RUSSIAN DANDELION (*Kok-saghyz*): The humble plant to which botanists were first attracted when they heard of semi-nomadic tribesmen using it for a sort of chewing gum. Now it helps to cushion the wheels of the Soviet armies driving the enemy from the Ukraine

U. S. Department of Agriculture photograph

U. S. Department of Agriculture photograph by Purdy

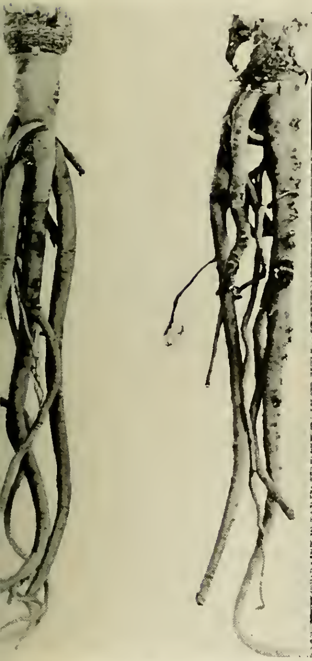
▲ SEEDS of the Russian dandelion flown from Kuibyshev Washington for experimental development of the plant North America. The seeds are accustomed to winter conditio in the Tian-Shan Mountains; therefore they have to be soak in water or kept on ice or under melting snow for fifteen d or more. Here Dr. E. W. Brandes of the United States Depa ment of Agriculture is examining the soaked seeds spread o to dry

Rubber

L. E. Rodin. Late in 1931 Doctor Rodin was exploring the wild Tian-Shan Mountains in the Republic of Kazakstan in Russian Central Asia. Here he heard reports of the picturesque semi-nomadic Kirghiz and Kazakh tribesmen, roaming with their herds in Turkestan, chewing a rubber-like gum called *kok-saghyz* (*kok* meaning "root," *saghyz* meaning "to chew"). In the high valleys of the Tian-Shan he found a lowly dandelion, hitherto unknown to science and as yet unnamed by botanists (now called *Taraxacum kok-saghyz*), which was the source of this gum. Hopefully, he dug as many roots as he could find. As he broke the dried roots, long elastic threads stretched out from

U. S. Department of Agriculture photograph

▲ GUAYULE is more famous than Russian dandelion in American rubber production, being a native of northern Mexico, southern Texas, New Mexico, and Arizona. Growth that would require 5 to 20 years in the desert can be attained in 2 to 4 years under cultivation



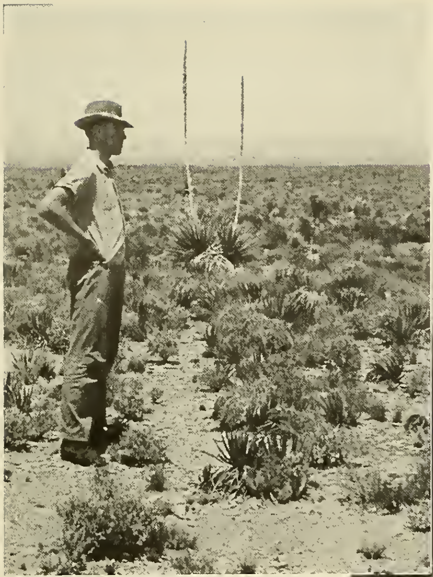
U. S. Department of Agriculture photograph

▲ THE ROOTS of the Russian dandelion contain the rubber. When broken, long elastic threads stretch out from them. Thomas A. Edison felt justified in studying our own dandelion for its small traces of rubber. Russian dandelion, almost indistinguishable to the non-botanist, yields as high as 20% of rubber from old dry roots

K. S. Swan: U. S. Department of Agriculture photograph

▲ AMERICAN-GROWN SEED being gathered from Russian dandelion plants cultivated on irrigated land near Missoula, Montana: a scene from one of the projects undertaken by the Forest Service of the U. S. Department of Agriculture

◄ **Guayule** grows wild among other desert plants and looks like a cross between alkali-weed and greasewood. The plants are mostly widely scattered. But as early as 1904 a Mexican factory was established to produce a million pounds of wet rubber a month



Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Dept. of Agriculture

▼ **Rubber** from guayule as it appears after the chopped-up plant has been put in water, allowing it to float to the surface

Farm Security Administration photo by Lee

them. The dandelion with which our own Thomas A. Edison had experimented (*T. palustre* var. *vulgare*) contained only small traces of rubber, but this new species—almost indistinguishable from the common one to the non-botanist—had 6 to 7½ per cent of rubber in the dry weight of its year-old roots! In some older plants the figure goes as high as 20 per cent!

In 1942 Russia is reported to have devoted 2,000,000 acres to growing kok-saghyz. Like all dandelions, it contains its rubber in the lactiferous tubes of the root and other parts, but Nature gave it more to begin with and Russian botanists have increased the percentage by careful selection and breeding. Possibly our own native species of dandelion and the common introduced European weed of our lawns could also have had their rubber-content raised through breeding. But the United States had more promising plants (like guayule and goldenrod) to use as starting-points, and until now our country never had the urgent economic incentive for self-sufficiency in rubber.

Last year 139 pounds of kok-saghyz seeds were flown by plane to the United States from Kuibyshev, Russia. These were as carefully apportioned as though they were diamonds and were planted at agricultural experiment stations in 25 states, as well as in co-operating stations in Alaska and Canada, to see where they would grow best. After greater supplies of seeds were received, larger-scale plantings for seed production were established by the Forest Service at six localities. At present kok-saghyz is growing in 42 states, in Canada, Alaska, Chile, and Argentina. Tons of seeds were imported from Murmansk, via Iceland, and from Bazra, in Iraq, around the Cape of Good Hope. A second air shipment from Russia arrived in May, 1942, and was used to plant large areas in Michigan, Wisconsin, Minnesota, and Montana. A program of research, involving all the skill and equipment of the modern plant scientist, is under way to further improve kok-saghyz as a strategic rubber plant. Geneticists, plant-breeders, plant physiologists, agronomists, and plant explorers have all signed up for this war effort.

Kok-saghyz seed is minute and demands preconditioning to insure prompt synchronized germination and uniform plants. This involves a simulation of winter conditions in its Tian-Shan homeland—soaking in water or keeping on ice or under melting snow for 15 days or more. After that it is easy to cultivate. All it needs is weeding and an average amount of rainfall or irrigation. It readily responds to the use of fertilizers, which increase the rubber-content of its roots. More than 18,000 pounds of kok-saghyz

◄ ALL PARTS of the guayule plant except the leaves contain rubber. These three-year-old shrubs, grown in California, will yield about a pound

U. S. Dept. of Agriculture photo by Forsythe

▼ A GREENHOUSE FULL of guayule plants at the U. S. Horticultural Station in Maryland. Here plant scientists are seeking to learn the best conditions of soil, fertilizer, and moisture. The pots in the foreground, grown without regular soil, are receiving special nutrient solutions, those in the background, different kinds of fertilizer

U. S. Dept. of Agriculture photo

roots have been harvested from the first experimental plantings. Most of the rubber is in the long underground tap-roots, so the crop is harvested by digging the roots. The roots keep on growing in the frozen ground long after the leaves have been killed by the frost. Rubber may be harvested in 6 to 12 months, with a yield of about one ton from 16 acres. In Montana the yield was estimated at between 4500 and 5000 pounds of roots per acre, or 45 to 55 pounds of rubber per acre. This yield is greater than the average in Russia, but is from irrigated land. In Russia only dry land is utilized. In Canada the yield has been from 1600 to 8100 pounds of roots per acre.

In Russia the roots are processed in sugar-beet factories, and the areas in the United States where kok-saghyz appears to grow best coincide with our present sugar-beet growing regions. But with the present manpower shortage the prospects of synchronizing the production of sugar-beets and dandelions on a large scale do not appear to be too promising.

More famous in American rubber production, however, is the native guayule (pronounced: *"wy-oó-lay"*). Its scientific name is *Parthenium argentatum.* This is a lowly desert shrub, growing wild on limestone slopes, covering an area of about 20,000 square miles in northern Mexico, southern Texas, Arizona, and New Mexico, where there is an annual rainfall of 9 to 15 inches and the summers are long, hot, and dry. The plant looks like a cross between alkali-weed and greasewood. Early efforts to domesticate guayule by rubber companies failed. Success was not achieved until Dr. W. B. McCallum, botanist of the University of Arizona and authority on desert plant life, was asked to tackle the job. In its native haunts it is a stubby, widely branching, woody shrub, seldom more than 30 inches tall, with small silvery leaves that give it a dusty appearance. Rubber is stored in all parts of the plant except the leaves and may amount to as much as 22 per cent of the dry weight, although the average for wild plants is about 8 per cent. By cultivation the life cycle of this normally slow growing plant may be telescoped so that growth which would require 5 to 20 years in the desert may be attained in 2 to 4 years. Plants are usually ready for harvesting at the end of the fourth year. If not harvested, they may live for 40 to 50 years.

A commercially practical method of extracting the rubber from guayule was perfected in 1904, and in that year the first factory was established at Torreón, Mexico, with a capacity of 1,000,000 pounds of wet rubber per month. Later more factories were built elsewhere in Mexico, and production has been almost continuous ever since. Five to ten million pounds of guayule rubber have been secured annually from wild Mexican plants since 1906. A factory was operated in Texas for some years until the supply of wild plants was exhausted. In fact, so extensively were the wild plants dug up that after a few years it was estimated that the supply of wild plants in existence would not last more than 17 years. Collectors then were cautioned only to harvest mature shrubs, and now the Mexican Government controls the collection of the plant by requiring permits, issued through the Forestry Department, and by fixing the minimum size of plant that may be taken. As a result of these measures it is now estimated that a constant production of 7000 to 10,000 short tons of guayule rubber is possible annually in Mexico without depleting the wild supply.

The rubber of guayule does not occur in latex tubes, as in rubber-trees, but is secreted in separate cells. In harvesting, the entire plant is pulled up—roots and all. It is chopped up and ground in water. The rubber then floats to the surface.

U. S. Dept. of Agriculture photo by Forsythe

◂**Boron** has been excluded from the "diet" of the plant being examined here by Dr. J. W. Mitchell. Other rows received different amounts. The experiment seems to show that soil selected for guayule plantings should contain ample boron

U. S. Forest Service photo by Carl A. Taylor

➤ **Plantations of guayule totalling 20,000 acres have been established in various parts of the United States and in Argentina and Chile. In this view nursery crews in California are removing seedlings for transplanting. Note the rows of irrigation sprinklers**

Plantations totaling more than 20,000 acres have been established in the Salinas Valley and other favorable locations in California, and elsewhere in Texas, Arizona, New Mexico, Argentina, and Chile; but further expansion of cultivation is at present being held in abeyance because the food shortage demands the use of all available land for food crops. Vast stocks of guayule seeds and seedlings, however, are being held in reserve by the Department of Agriculture in the event that the emphasis should again shift from food to rubber production in those areas. In its native haunts solid stands are seldom seen, and one may travel 20 or 30 miles without coming upon a specimen. A pound of its seed contains some 600,000 seed-envelopes, usually less than 10 per cent of which contain fully developed seeds. Germination is, therefore, poor and must be carried out in nurseries —the seedlings being later transplanted to the plantations, where they are cultivated like corn. At harvest time, the plants are plowed up, windrowed, gathered, and shredded by special equipment in the field. At the factory the shredded plants are crushed and run through revolving tubes where heavy flint stones in water macerate the fiber. The rubber particles then form small masses, while the fiber becomes waterlogged and sinks, permitting removal of the raw rubber. The rubber masses are then placed on trays, dried, and pressed into 100-pound slabs for shipment. This rubber contains 16 to 20 per cent resin, but when deresinated is equal in quality to high-grade *Hevea* rubber. As an emergency source of natural rubber, guayule is unrivaled. Without the deresinating process it is not equal to *Hevea* rubber and is more costly, but as a stop-gap until the new *Hevea* trees become productive, it may well be a lifesaver.

Another important source of rubber that is making the headlines these days is the so-called *crypto-vine* or *Madagascar-vine (Cryptostegia grandiflora* & *C. madagascariensis).* These are showy flowering vines in the dogbane family, which have graced verandas and trellises in California, Florida, Mexico, and Central America for many years and may now become one of the most important sources of natural rubber in the Western Hemisphere. They are natives of tropical Africa and Madagascar, widely cultivated in India, and are considered to be among the best sources of latex known. Some 25,000 acres have been planted in Haiti and are expected to begin yielding in the first quarter of 1944, with 65,000 to 75,000 additional acres due to go into production in the second quarter. About 1,000,000,000 plants are in nurseries ready for planting up to a total of 100,000 acres.

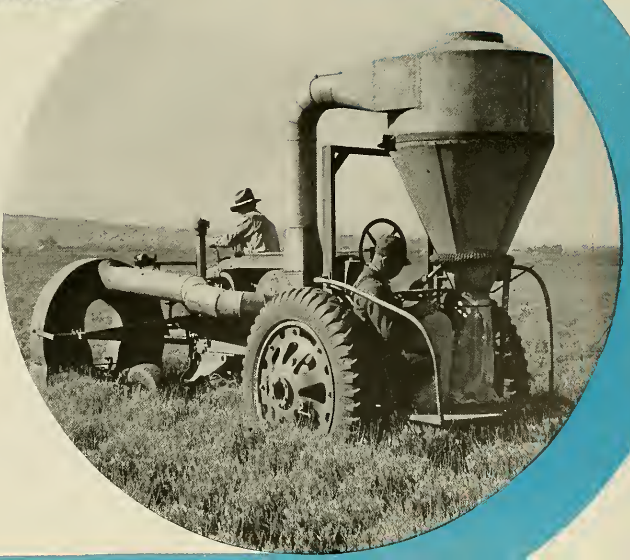
Cryptostegia is one of the quickest-growing plants producing highgrade rubber. It may be harvested after the first year, and claims have been made that mature plants may yield some 250 pounds of rubber per acre. Its rubber cures well and has good tensile strength. Its resin content makes it suitable for mixing with synthetic rubber. Production offers the advantages of requiring little steel or other strategic material and little skilled labor. It is estimated that one man per acre can easily harvest the crop.

Cryptostegia has been known for more than a century. A crude rubber has been made from it and marketed in a small way as *Palay rubber* from Madagascar to India. The vine was brought to Mexico in 1895 by a sea captain, who gave some seeds to a friend in Mazatlan to grow as an ornamental. The plant quickly spread to other parts of Mexico, California, Florida, and the West Indies. It is a tropical or subtropical plant, and its cultivation is limited to frost-free areas. It is grown from seeds in good soils suitable for general truck crops, and growth is rapid. The rubber-yielding latex is present in the leaves and stems. After a year's growth for development of a sturdy root-system, severe pruning will yield both leaves and stems without injury to the plant. Older trunks, which may attain a diameter of 5 to 6 inches, may also be tapped. Most often the vines are grown in hedgelike rows and the stems trained over bamboo troughs. Incisions are made in the stems, and the latex will then drip into the troughs for collection. The bleeding is done every 2 days and does not injure the vines. About 4000 plants can be grown per acre. The collected milky latex is screened and then coagulated in a mixture with water. The coagulum is lifted off in sheets and milled to squeeze out the water, then cured by smoking to complete the drying process.

Very similar to guayule is the rubber that lies hidden in the stems and roots of rabbit-brush *(Chrysothamnus* spp.). Estimates of the amount of rubber that could be secured from this weedy plant, which inhabits the alkali flats and other wastelands of the West, range from 10,000 to 250,000 tons. It is a shrub whose 16 species grow from knee-high to twice the height of a man and occupy an immense area from the northern Rockies to southern California. Its rubber occurs in the form of solid bits and shreds embedded in the tissues of the plant, like in guayule, and so the methods of harvesting would be similar. It is not thought that the *chrysil rubber* obtained from rabbit-brush could successfully compete under nor-

◂ GROWTH is better where ample water is provided, though guayule can be raised on either irrigated or dry land. A scene in the Salinas Valley, California

U. S. Forest Service photo by Palmer



▾ GATHERING GUAYULE SEEDS by means of vacuum, at Salinas, California

Farm Security Administration photo by Lee, U. S. Dept. of Agriculture mal conditions with the rubbers previously mentioned, since it is not quite so high in quality and the cost of preparation would probably be high. However, in the present and similar emergencies it might be found worth-while.

U. S. Forest Service photos by Carl A. Taylor

▲ **Seed harvest from two days' picking: sacks at Salinas awaiting transporation to the cleaning mill**

▼ **Enough seeds for hundreds of millions of rubber-producing guayule plants**

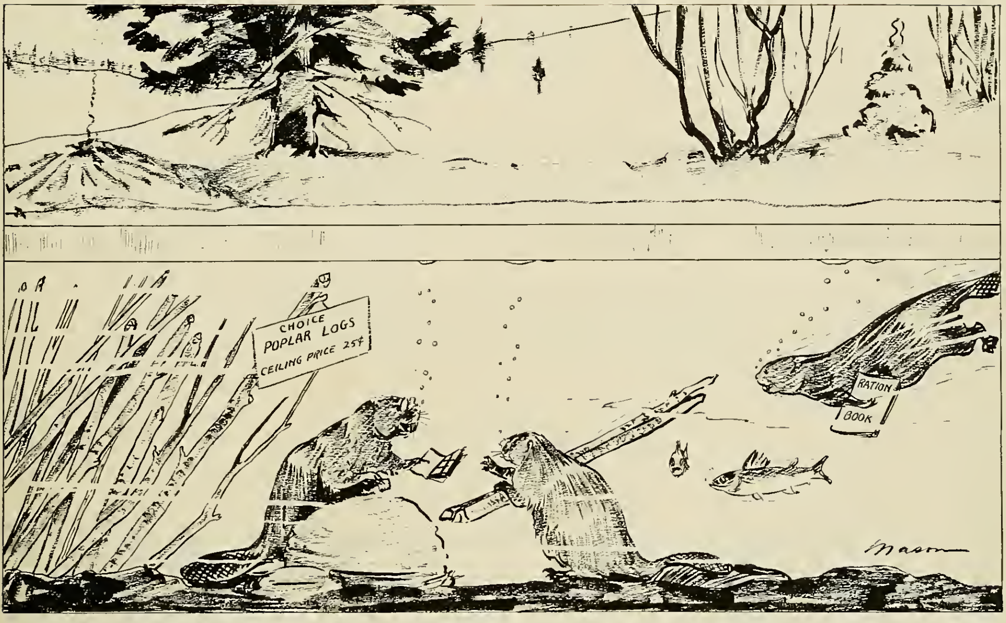
Another type of rubber much discussed recently is *chilte rubber*. This is derived from species of the genus *Cnidoscolus* in the spurge family. There are about 40 species in the group, of which 11 are native to continental North and Central America. They range in size from herbs to shrubs and even trees, having stinging hairs and showy white flowers.

Rubber-like substances with at least part of the stretch and bounce of real rubber are now being prepared from corn (*Zea mays*) and soybean (*Soja max*) oils. Some of these products will stretch 200 per cent or more and return to their original shape. They show tensile strength of about 500 pounds per square inch (natural rubber averages 600 per cent stretch and a tensile strength of 3000 pounds or more). The product from soybean oil is known as *norepol* and possibly represents the greatest potential utilization of soybean oil yet discovered. It is deemed of such importance to the war effort that a secrecy order has been placed upon it. It has good resistance to abrasion and is impervious to water and alcohol, so that it can replace rubber in such uses as insulation, shoe heels, fruit-jar rings, gaskets, and tubing. Demand for *norepol* is estimated at 12,000 or more tons for the current year. Another product from soybean protein and other vegetable proteins is even more elastic than rubber and has great strength. It is applied in the form of a liquid. When spread over a surface and dried, a thin brown film is formed which is considerably more elastic than natural rubber and is entirely unaffected by fats, oils, and grease, so that it is admirably suited for gaskets and the like.

Thus we see how the patient labors of botanists, in co-operation with chemists and physicists, are revealing hitherto unsuspected products of strategic importance in common plants. And when we think of the hundreds of uses for which we have come to depend upon the substance we call Rubber, we may be surprised to realize that the origin of the word itself is to be found in the original European use for rubber—to "rub out" or erase mistakes.

[Next month: Quinine]

UNDERWATER STORE



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

BEAVERS used to be found from Alaska and Labrador to the Rio Grande and across northern Europe and Asia. The winters are cold almost everywhere they live, but unlike their distant relatives, the woodchuck and chipmunk, they do not hibernate. They remain lazily active during the cold weather when their ponds are sealed with a thick coat of ice.

During the summer they eat many succulent pond plants, duckweed, pond lilies, reeds, and even algae, but most of these wither and die in the fall and the beaver's diet through the winter is bark. Autumn is a very busy season for these rodents. From dusk to dawn they work to cut their food trees, for they must have a store of bark before the water freezes.

Beavers like the bark of the aspen, or poplar; the bark of the branches and top of trees is the best, for it is the new growth. To our taste the beaver makes a strange choice, because poplar bark is as bitter as gall. If aspens are absent or scarce, maple, willow, alder, and many other trees are used for food, but pines and spruces are rarely touched.

A beaver picks out a tree, on which two sometimes work together, one on each side. They sit up on their haunches, braced by the tail, and begin to bite great chips from the trunk. The bites are up and down, diagonal and some even horizontal. Beavers keep their chisel-like front teeth sharp by grinding the upper and lower ones together; all the hard enamel is on the front side of the teeth, while the rest of the incisor is of softer ivory. When the tree is cut almost through and begins to crack, the beavers run out of the way.

Then the branches are trimmed off and the best part of the tree is cut into pieces that can be dragged to the water by a beaver. Each piece is towed out to deep water near the lodge and sunk. The green wood is not very buoyant, so sinking it is not much trouble, but the first pieces must be pushed down in the mud to anchor them, then others can be tangled in these. If the sticks are left on shore for long the bark becomes dry and the juices ferment, but under water it keeps very well.

During the winter the beavers live snugly in their nest above water level in a "lodge," made of sticks and mud. They spend most of the time sleeping and resting from the summer's exertion, but every now and then one or another of the beaver family goes out through the water-filled passage to the pond. He swims to the sunken store of sticks and logs, pulls one loose, and tows it back to the nest for a meal.

ON YOUR RADIO

Program of the American Museum of Natural History for December, 1943.

WEDNESDAYS over WNYC
from 3:30 to 3:45 P. M.
Science for the Seven Million

Dec. 1—*Underseas Painting and Photography*—CHRIS E. OLSEN
Dec. 8—*Xmas Books for the Home Front* EMILIE CORSON
Dec. 15—*Camouflage*—JOHN R. SAUNDERS
Dec. 22—*Children's Xmas Program*—CATHERINE BARRY
Dec. 29—*Greenland and Iceland*—DR. HELGE LARSEN

This program is now under the sponsorship of NATURAL HISTORY Magazine.

THE BENEFICIAL SERPENT

By CHARLES M. BOGERT

Curator of Recent Amphibians and Reptiles

Fascinating facts about creatures that both kill and cure

Two men carrying heavy packsacks were trudging along a narrow trail that wound through the dense foliage of a tropical rain forest. Suddenly something struck the packsack of one of them. Turning, he caught a glimpse of the scaled underside of a large snake. Yelling in fright, he loosened his arms from the straps and dropped his burden. The fangs of an eight-foot snake were still impaled in the canvas pack, and the huge reptile was killed with a machete. This happened in the jungle of the upper Amazon. The snake was a bushmaster.

A soldier wrote: "Yesterday evening as Lieutenant Gibson of our regiment was going to his quarters for mess he saw a snake, at which he proceeded to throw a stone. He then called for a light and a stick, and as he was bending down with the light to look for the snake, it made a dart at him. Some of the poison was ejected into Lieutenant Gibson's eye, causing instant and great pain, and the eyelids swelled up quickly to the size of a large hen's egg." This happened in Burma. The snake was a spitting cobra.

Camp had been established for two days. Men on the expedition had gone about their business of searching for fossils, repairing their trucks, making their maps, and performing the numerous tasks that confront any group of explorers. A couple of small venomous snakes had been seen near their tents, but no one thought much about it. Then one day the temperature began to rise. That evening it was warmer than it had been. A man lying on his cot saw a snake wriggle across the patch of moonlight in front of the tent. Deciding to investigate, he turned on his flashlight before he got up. To his amazement he saw that no less than half a dozen snakes were in his tent, entwined about the legs of his cot, compactly coiled on the floor, or with their sinuous bodies protruding from under the edges of boxes of equipment. The entire encampment was in an uproar within a few seconds. Lights went on in all tents, and snakes—scores of them—were found, literally in every tent.

This happened in the Gobi Desert. The snakes were pit vipers. Apparently they were emerging from their den which unhappily was also the camp site of the Central Asiatic Expedition. This incident has been made famous by Dr. Roy Chapman Andrews, who was leader of the group. The locality was appropriately named "Viper Camp."

Everyone has heard or read similar well-authenticated stories—and doubtless others not so well authenticated. Venomous snakes are found on every continent, on many islands, in valleys and in mountains, in the tropics and in the temperate zones, even inside the Arctic Circle in northwestern Europe where the subsoil is not permanently frozen. There are venomous snakes in the sea, along the shores of the Pacific and Indian Oceans. But your chances of encountering a venomous snake are not actually great, even under favorable circumstances.

More people are killed every year from the accidental discharge of firearms than die from snake bite. In the

United States there is greater likelihood of your being struck by lightning than of your being killed by a venomous snake, and even in the tropics the odds are nearly as great. Expeditions into tropical regions have often found it difficult to assemble 100 snakes a year, of which only a small percentage were venomous. And these expeditions were looking for snakes! Botanists, geologists, and similar explorers have been months in the tropics without so much as seeing a snake.

However, I have no desire to imply that snakes are not common in many parts of the world, nor is it desirable that no precautions be taken. Snakes unquestionably are often present in far greater numbers than one might suspect. A competent field worker spent three years collecting in eastern Colorado and found scarcely half a dozen rattlesnakes. Then he located a "den," a place where snakes had congregated to hibernate in a group of prairie-dog burrows. Within two weeks he had captured over 800 rattlers emerging from their winter quarters.

So snakes are really rather plentiful in many regions, but we neither see them nor are we bothered by them. Why? There are several reasons.

First, most snakes are nocturnal. Contrary to popular notions they cordially dislike sunlight except in early spring months and for the briefest exposure during warm summer days. They prefer to do their hunting at night, perhaps because they find it necessary to avoid the heat of day.

Second, many snakes are secretive. They remain hidden much of the time, and even when they are abroad, their colors so completely harmonize with their surroundings or their patterns disrupt the body contours so that it is difficult to see them. I have known of a case where 40 persons walked within a yard of a three-foot rattlesnake, and failed to see it.

Finally, venomous serpents attempt to avoid enemies and they are equipped with fangs primarily for the purpose of killing their prey. Ordinarily snakes venture forth from their seclusion only to mate or to feed. They do not wander about aimlessly as was formerly believed. Indeed, snakes possess highly perfected sense organs that permit them to locate their prey with a minimum of effort. Snakes that habitually seek their food at night have evolved eyes adapted for seeing in dim light, like those of a cat. Others have evolved extremely sensitive heat receptors that enable them to detect the presence of warm-blooded animals in total darkness, and to strike and kill their prey with the precision of a modern weapon. These heat receptors are located in small pits or depressions in the face or lips of many snakes, including many pythons, boas, and pit vipers. In fact, the name "pit viper" is derived from these facial pits so obvious on the rattlesnake, bushmaster, water moccasin, and fer-de-lance.

Strangely enough, snakes do not detect odors through their nostrils. Rather the tongue is continually thrust out and drawn back, carrying with it minute particles of odorous substances that are brought in contact with paired receptors located in the roof of the mouth. A peculiar mechanism indeed, but apparently most efficient; the fresh trail of a rodent is, without doubt, followed with greater precision than that of a fox by a hound.

The forked tongue is commonly mistaken for the fangs, but true fangs, or venom-conducting teeth, are visible only when the snake's mouth is opened and the investing tissue drawn back. These special tubular teeth, the prototypes of our modern hypodermic needle, were evolved by snakes at least fifteen to twenty million years ago. Needless to say these modified teeth, or fangs, represent an efficient means of injecting poison into the snake's prey.

No single feature provides a reliable means of distinguishing venomous snakes, except the presence of fangs. If a snake has fangs, it is poisonous beyond question. All rattlesnakes are venomous, of course, but many snakes related to the cobras look superficially like harmless serpents. Australia in particular is unique among the continents in possessing more species of venomous snakes than of harmless snakes. Yet no vipers or pit vipers are known from Australia, and many venomous snakes look superficially like our common racer or black snake. Actually the venomous serpents of Australia are all primitive relatives of the cobra.

Two cobras in Africa and one cobra in the Malay region have evolved special fangs that direct the venom outward, perpendicular to the fang, instead of downward, so that the snakes are able to spray venom for a distance of seven or eight feet. And these cobras aim with precision for the face of an adversary. Furthermore, the venoms of these cobras are readily absorbed in the eye, causing serious effects and permanent blindness unless the venom is removed immediately. Such cobras, therefore, have fangs that serve a dual purpose. They serve to prevent attack by an approaching enemy, but they also serve as injectors of venom when the cobra kills its prey.

Most vipers and pit vipers have long, curved fangs that can be rotated with the jaw, so that they are folded back against the roof of the mouth when they are not in use. Cobras and sea snakes, on the other hand, have permanently erect fangs that fit into pockets in the tissue outside each lower jaw bone. Because their fangs cannot be rotated, cobras and their allies, among them the kraits, mambas, and coral snakes, have relatively short fangs. Those of the king cobra, 18 feet long, the greatest length attained by any venomous snake are scarcely ⅝ of an inch in length, while the thick-bodied Gaboon viper of the African Rain Forests possesses the longest fangs of any living snake. A six-foot Gaboon viper, with a head the size of a man's fist, has fangs almost two inches long, and its venom is one of the most powerful known. Nevertheless, human casualties from the bite of the Gaboon viper are rare. Although if molested it is more than capable of defending itself, this powerful serpent is simply not an aggressive beast. Fortunately this is true of the majority of venomous snakes. Only the king cobra and the bushmaster often attack without provocation, probably because each of them guards its eggs during a long incubation period, and an occasional traveler comes too near the "nest."

So it is that the Surgeon-General's Departments of both the Army and Navy report casualties from snake bite to be "almost negligible." Our armed forces have, of course, taken all precautions to maintain this record. Scientists in many parts of the world have produced antivenins to counteract the venoms of various snakes. This is a difficult task, because no two species of snakes have the identical venoms, and it follows that the venom of each species must be used to prepare a reliable antivenin for that particular kind of snake. Some of these antivenins may be put to good use by the American expeditionary forces, although prompt incision and suction at the site of the bite sometimes preclude the necessity of using serum.

Perhaps you would recommend that venomous snakes be exterminated? Even if this were feasible—and it isn't—it is extremely doubtful whether their extermination is desirable. In teeming India, where the incidence of snake bite is reportedly high, it is unlikely that the average span of life in that country would be lengthened by the destruction of snakes. A competent authority points out that the increase in rodents as a result of the removal of the snakes would almost certainly result in an increased death rate from bubonic plague and other rodent-borne diseases.

Scientific opinion holds that it is preferable to keep the snakes, even venomous species, in order to retain a balance in nature. But scientists have gone beyond this. Medical investigators have put venoms to work for man. Some of these poisons in minute doses actually constitute valuable medicinal agents. Cobra venom is used to alleviate pain, replacing opium in serious cases, and it has the distinct advantage of being non-habit forming. Rattlesnake venom has been employed with success in the treatment of epileptic seizures. Moccasin venom is used therapeutically to promote coagulation of the blood, thereby stopping hemorrhage. Viper venom is useful in the treatment of hemophilia, the inherited disease which permits profuse bleeding from very minor wounds.

Many of us are inclined to think of the terms "drug" and "posion" as referring to quite different substances. But the pharmacologist knows that many, if not most, drugs are also poisons. Consequently pharmacologists, by a reversal of this reasoning, often look upon poisons as possible medicinal agents. Under certain conditions almost any poison exerts a useful medicinal action and therefore may be regarded as a therapeutic agent. Snake venom is no exception.

Of course, this does not mean that snake bite is a cure for disease. Rather, it should be explained that investigators noticed that the venoms of certain snakes, particularly those of the water moccasins and Russell's viper, promoted coagulation. Bites from the water moccasin cause thickening of the blood at the place where the venom has been injected, and the resulting congestion, or lack of circulation, in the arm or leg bitten, may produce quite painful effects. The pharmacologists made note of these symptoms, but reasoned further: if moccasin venom were prepared in dilute solution, might it not then serve to coagulate the blood to the extent needed by hemophiliacs? However, scientists do not propound questions for others to answer. It is the scientists' job to answer questions, and this is what the pharmacologists did. By careful experiments they demonstrated that in suitable doses moccasin vemon could be employed with a measure of success in stopping the flow of blood in cases of severe hemorrhage.

Cobra venom, in contrast to that of the moccasin and Russell's viper, does not exert any serious effect on the blood. Rather its effects are principally upon the nervous system, and when death occurs from the bite of a cobra it is because certain nerves cease to function. Again the medical investigator seized upon this fact and sought to put it to good use—not without success. If cobra venom causes nerves to stop functioning, why not use cobra venom to stop pain? After all, pain is the result of a nervous impulse, and if cobra venom will inhibit the function of one nerve, why not apply it to another?

The reasoning is simple, but the actual work involved has been tremendous. Cobra venom had to be purified and sterilized by special processes to remove dangerous bacteria. Then the venom had to be standardized so that suitable dosages might be given, needless to say in considerably diluted solutions. Promising results have been achieved with cobra venoms in reducing pain in incurable diseases, and the research continues. Not one disease, but several, have responded to treatment with dilute, standardized preparations of cobra venom.

Carefully controlled use of snake venoms is a modern development. In ancient times various parts of the snake were often used in the preparation of elixirs or other reputed cure-alls. But more often than not the venom itself was not used, because the head containing the poison glands was carefully removed. Not that it made any difference, because the effects of the preparations were purely imaginary.

It is not astonishing that snake venoms have been turned to man's use only within recent years. Venoms are extremely complex substances. The active principle of venoms is a protein that has a complex formula which includes the elements carbon, hydrogen, sulphur, and nitrogen. Most venoms, as a matter of fact, contain more than one principle. Consequently, many of the venoms still defy chemical analysis. The first effort to break down snake venoms was made almost precisely 100 years ago, and today we know the chemical formulas of scarcely more than two or three snake venoms, and the exact formulas of these are uncertain.

Much of the original modern scientific work was undertaken in the Pasteur Institute in France, but now researches have been carried on in South Africa, in India, and in the United States. Dr. David I. Macht, one of the leading pharmacologists in this country, has conducted extensive researches with a variety of venoms, and he has demonstrated their value in the treatment of a number of diseases. Research will continue, of course, with many specialists contributing to the problem. To standardize the venoms it is necessary that each of the several types of snakes from which venom is extracted be classified correctly, that it be known, for instance, precisely which kind of cobra produces which kind of venom. This work of classifying cobras falls to the museum investigator who deals with preserved specimens. The chemist may eventually contribute his share by analyzing more of the venoms extracted. Meanwhile, the pharmacologist, working with animals, will observe the effects of the various venoms or of products derived from the venoms. Eventually, the number of uses in medicine to which venoms may be put will certainly increase.

So the bushmaster in the tropical forests, the spitting cobra in the Burmese jungle, and the pit viper in the Gobi Desert all have their dangerous attributes. But they have their useful aspects as well. Venomous snakes not only serve a useful purpose in keeping the disease-bearing rodents in check, but modern science has transformed the venom from a deadly weapon to a useful medicinal agent. The serpent has been deprived of its terrors by the use of modern methods of treating snake bite, including antivenins, while the potent poison derived from the dangerous snake proves to be a useful drug. It may be desirable to kill dangerous snakes in densely populated areas, but it has become difficult to argue that venomous snakes should be exterminated.

YOUR NEW BOOKS

KNOWING THE WEATHER ● EDIBLE PLANTS ● DUNE BOY
TAXIDERMY ● ALASKA ● ELEPHANTS

ISLAND PEOPLES OF THE WESTERN PACIFIC, MICRONESIA AND MELANESIA

- - - - - - by Herbert W. Krieger

Smithsonian Institution War Background Studies Number 16

UNLIKE the East Indies, the island world to the eastward was long neglected both economically and strategically, until our attention was painfully directed to this part of the Pacific by the culmination of the Japanese plot. It is doubtful that these islands known collectively as Melanesia and Micronesia will soon again relapse to their former insignificance in our postwar arrangements.

Although Melanesia and Micronesia have been merely names and not always that to most of us, they have long occupied a place of special interest for anthropologists who have been active in recording anthropological data on some of the native peoples living there. From these studies Doctor Krieger has distilled out a summary description of native life that makes an excellent, short introduction to both areas. He makes clear not only the essential distinctions between Melanesian and Micronesian culture, but also differentiates the various island groups within each area.

H. L. SHAPIRO.

EDIBLE WILD PLANTS OF EASTERN NORTH AMERICA

- - by Merritt Lyndon Fernald and Alfred Charles Kinsey

Idlewild Press, Cornwall-on-Hudson, $3.00

THIS book is a Special Publication of the Gray Herbarium, the senior author being Fisher Professor of Natural History and Director of the Gray Herbarium, Harvard University. Doctor Ferald was also a coauthor, with Doctor Robinson, of the last revision of Gray's *Manual of Botany*. Doctor Kinsey, coauthor of the book now being considered, is Professor of Zoology in Indiana University.

A few years ago there appeared an excellent volume with almost the same title, namely *Edible Wild Plants*, by Oliver Perry Medsger, which covered most of United States and Eastern Canada. The present work is more complete, as would be expected in a larger book covering a smaller area. Moreover, the new Fernald and Kinsey book contains a valuable section entitled *Poisonous Flowering Plants Likely to Be Mistaken for Edible Species*, in which are considered poisonous bulbs and roots, poisonous new shoots resembling edible plants, poisonous dry fruits or seeds resembling edible seeds, and poisonous berries.

This is a timely book. Many persons will be grateful, in these days of rationing, that dependable scientists have assembled what is known about the many edible wild plants. Everyone who tramps the fields and woods knows certain wild berries, such as strawberries, blackberries, raspberries, blueberries, and elderberries, and certain nuts such as hickory nuts, walnuts, and hazelnuts; but few go further than fruits and nuts in wild plant food. Some eat dandelion, dock, and poke greens, but few realize that there are hundreds of other edible plants.

Purées from young flowering spikes of cattail, starchy or mucilaginous soups from seaweeds, lichens, manna grass, tubers of Jerusalem artichoke, chufas, and nut grass; roots of groundnut and wild salsify; rootstocks and seeds of water chinquapin, oaks, beech, walnuts; seeds of wild rice; breadstuff from the inner bark of pine and hemlock; potherbs or greens from docks, marsh-marigold; as drinks, sassafras and spicebush tea, New Jersey tea, and Labrador tea; Kentucky Coffee-tree seeds, chicory roots, sunflower seeds, and many other substitutes for coffee; maples and other sources of sugar; confections of coltsfoot and sweet flag (calamus) root—these are just a few of the edible wild plants treated in this authentic manual.

CLYDE FISHER.

KNOWING THE WEATHER

- - - - - by T. Morris Longstreth

The Macmillan Company, $1.69

IN Death Valley the temperature once reached 134° F., and in Siberia it dropped to —90° F. Liquid water droplets float in the air at 20° below zero Fahrenheit without freezing. There are 7 different kinds of fog, and nearly 74 feet (not inches) of snow fell in one winter in California. Hurricanes could not occur if the earth were not a spinning planet.

If the above rather disjoined facts of meteorology strike you as strange or startling, it is because you have not read T. Morris Longstreth's *Knowing the Weather*. The author has packed a wealth of information on all phases of weather study into 150 pages of excellent writing. Factual, human, whimsical, statistical, he will instruct you if you are interested, and interest you if you are not. The chapter on Thunderstorms ends with this "stroke:"

"If a human being were required to pay admission to thunderstorms, they would be admired and marveled at. People go to much trouble and expense to produce and see fireworks on July 4th. They are disappointed if the show has to be postponed because of a display of lightning."

The book is illustrated with beautiful cloud photographs. They illustrate the various types that help a great deal in forecasting. The technic of telling tomorrow's weather is really the theme of the book. Longstreth encourages the reader to learn to make his own forecasts, and gives, toward the end of the book, specific rules for doing so. He discusses climate change. Did you know that the ninth century was very wet, while the tenth and eleventh were warm and dry? No doubt the people said the climate was changing and that the "old fashioned" winter was disappearing.

Weather today is important, and growing more so. A great deal of meteorological literature is appearing. Most of it is written around flying. This author does not omit that angle, but he emphasizes weather to the man on the ground as well. Weather is a companion of yours whether you like it or not. Why not get acquainted with it? You cannot do so more pleasantly than by reading *Knowing the Weather*.

A reviewer should always find some fault. I would have put in a weather map, sketches of barometers, hygrometers, and wind patterns, and included a few more items in the glossary and Table of Equivalents. But this reviewer did not write the book. T. Morris Longstreth did. And he did an excellent job.

WILLIAM H. BARTON.

COMING DOWN THE WYE

- - - - - - - - by Robert Gibbings

E. P. Dutton & Co., $3.00

THE Wye flows through Wales and England for 130 miles before it empties in the Severn Estuary. This book is not a guide to the river Wye but the author's expression of its atmospheric circumjacence. The individual quality that sets this book apart is the author's ability to portray the element of humor and to narrate wayside anecdotes along with the splendor and glory of the sunset. It is an

Christmas Reminders

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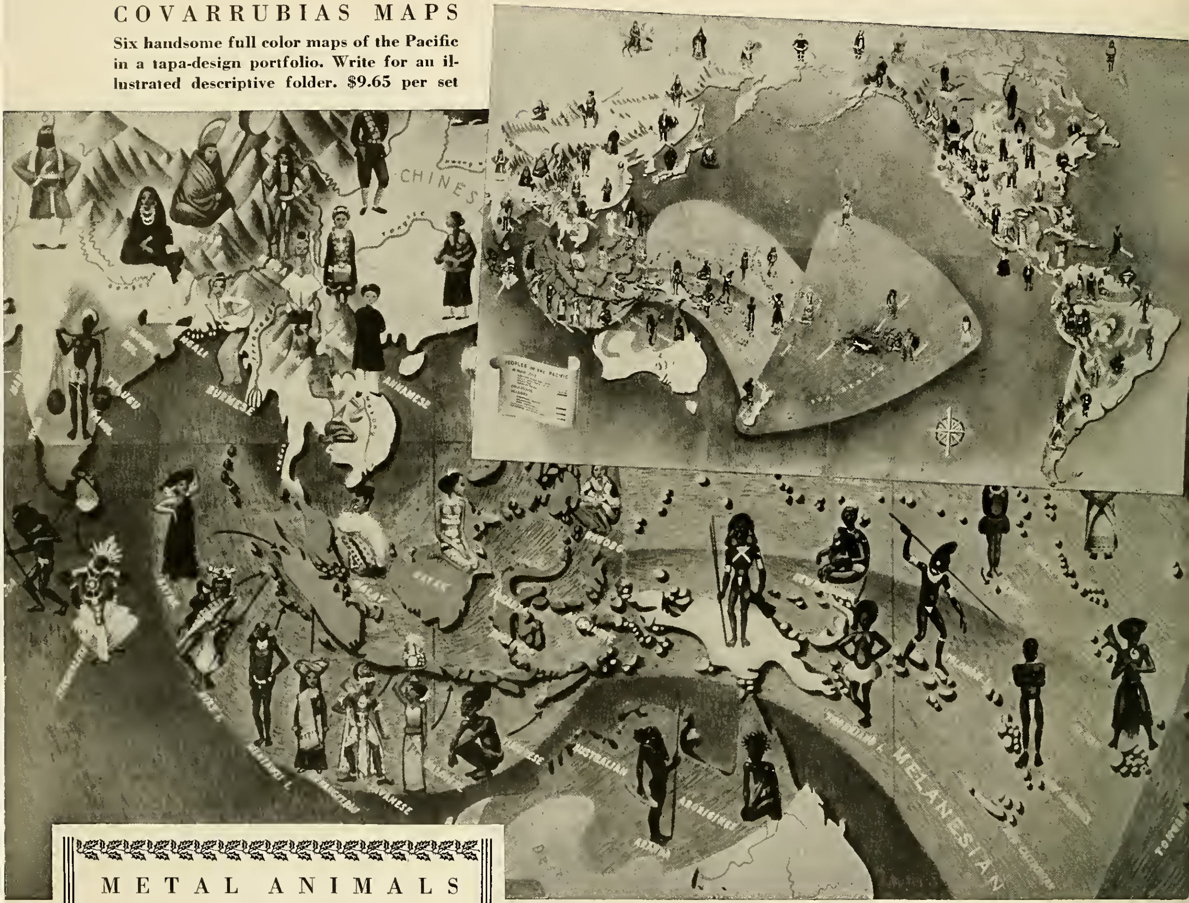

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The BOOK SHOP

THE AMERICAN MUSEUM OF NATURAL HISTORY

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enchanting story of natural history, folklore, and witchcraft mixed with travel on one of the most legend-haunted rivers in England and Wales. To gather his material for this book, Mr. Gibbings spent two years amid the wild and rugged beauty of the river. For months he lived alone with his pony in a derelict mountain cottage at the source of the Wye, but most of the time was spent actually coming down the river.

The book contains 189 pages, illustrated with engravings by the author, and is written in a rambling but delightful manner. Without impairing the readable quality of its pages, he has included sound facts of geological importance, studies in wildlife, and some of the peculiarities developed in human nature when isolated for generations.

Mr. Gibbings is an Irish artist, writer, and naturalist whose temperament leads him to disregard the conventional and follow his own line of interest.

George G. Goodwin.

THE BEHAVIOR OF THE SONG SPARROW AND OTHER PASSERINES

- - - - - by Margaret Morse Nice

Studies in the Life History of the Song Sparrow II, $2.75

(Available at the special price of $2.00 if ordered directly from the Museum.)

THE American Ornithologists' Union awarded in 1942 the Brewster Medal to Mrs. Nice for her song sparrow monograph, characterizing it as "the most important work relating to the birds of the Western Hemisphere published during the preceding six years."

Bird students throughout the world will be delighted to learn that the second part of this notable work is now available. Perhaps the most remarkable aspect of these studies is that they were not made by a professional, but by a busy housewife with four children! Mrs. Nice obtained her significant results by applying the modern technique of bird study. She did not study a species as such, but rather known individuals. By following the activities of color-banded individuals, she knew to whom they were "married," what their parents and children were, and which adventures they had throughout the year. This information, supplemented by the study of hand raised birds gave her a sound basis for generalizations.

The emphasis in the present volume is on behavior problems. Such topics are discussed as: The development and the activities of young birds; the daily cycle of activities; development, inheritance and function of song; the reproductive cycle in all of its phases (territory selection, pair formation, nesting, care of the young). Finally the question is discussed how much of the behavior is innate and how much learned.

In addition to publishing a wealth of original data, Mrs. Nice presents us with a well classified digest of the modern writings on bird behavior (29 pages of bibliography). This classic of the American bird literature should be in the hands of every student of birds or of animal behavior.

E. Mayr.

ALASKA: AMERICA'S CONTINENTAL FRONTIER OUTPOST

- - - - - - - by Ernest P. Walker

Smithsonian Institution War Background Studies Number 13

DURING the past year it has happened quite often that the American Museum has been asked for advice in selecting books for servicemen stationed in Alaska. Obviously the men have found themselves in a strange country, a country about which they knew very little but which fascinated them and stirred their curiosity. They wanted to find out about its geology, its fauna and flora, and the native population. The serviceman will find most of the answers in this little book, which really gives Alaska in a nutshell.

In 54 pages we learn about its topography, climate, population, natural resources, modern development, and the possibilities of the country. It is primarily a book for the person who wants a brief account of the facts about Alaska; for the one who wants to study the subject in detail there is a good bibliography. The text is accompanied by a large number of excellent photographs, well selected and most of them new.

Helge Larsen.

HERE COME THE ELEPHANTS

- - - - - - - - - by Gertrude Orr

The Caxton Printers, Ltd., Caldwell, Idaho, $2.50

TO the small boy, and to older persons as well, a circus means elephants, and no circus could be complete without them. There is something about their ponderous size and their capability of learning and performing that appeals to young and old alike. It is only after the most patient and painstaking schooling that an elephant is taught to do the unnatural procedures demanded of him to amuse the circus audience. In the book, *Here Come the Elephants,* Miss Orr has written of this training and of other interesting incidents behind the scenes. The hero and heroine of this book are Sultan and Princess Alice, two elephants that belonged to the Sells Floto Circus. This famous pair of breeding elephants produced four offspring within a period of eight years. Although none of these calves reached the age of more than a few months, the accomplishment was most noteworthy as there have been but two other live elephant calves born in the United States.

Certain chapters of the book deal with the elephant's ancestors, his habits in the wild, and his training and usefulness in his native countries of Asia and Africa. The author's statement that wild elephants may live to 120 and 150 years of age is questionable. It is now believed that half that age would be nearer the truth.

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Complete information on methods of identification, problems of bird counting, bird banding, etc.; appendix and bibliography. *Illustrated by Francis Lee Jaques.* $3.50

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By William R. Van Dersal. The story of the American land, the way it has been used—and misused. "A book to be read from cover to cover . . . a new guide book to the United States."—*N. Y. Times, 128 illus.* $3.75

OXFORD UNIVERSITY PRESS
114 Fifth Ave. New York 11

The book is very readable. Any person interested in elephants and wishing to learn more about these giant beasts will enjoy reading the pages. The book is illustrated with numerous photographs of circus and other tamed elephants.

T. D. C.

ISLANDS AND PEOPLES OF THE INDIES

- - - - - - by Raymond Kennedy

Smithsonian Institution War Background Studies Number 14

THIS little book on the East Indies by Professor Raymond Kennedy is designed to embrace within its brief compass a complex area rich in human history and cultural variation. In this difficult task the author has succeeded admirably. His account, necessarily confined to the main highlights, touches upon such generalities as climate, population, geography, and history. In somewhat greater detail the principal islands and groups are described with respect to their physical aspect, their economic status, and the character of their inhabitants. Following this, various aspects of native life are succinctly defined. This should be an extremely useful guide for those eager to form some conception of the life and the people of the East Indies.

H. L. Shapiro.

Dune Boy

- - - - - - by Edwin Way Teale

Dodd, Mead and Co., $3.00

In this volume the author of *Grassroot Jungles, Near Horizons*, and additional books that have implanted in others an understanding love for nature tells how the foundations of his own interest in living things were laid during the significant vacations spent on his grandparents' farm in the dune country of Indiana. The reminiscences begin when, as a small lad, he wriggled up the slanting mossy roof of their farmhouse, the better to view the distant enchantment of the dunes, and close with the golden age of his boyhood when, on the threshold of sixteen, he spent his last Christmas—snow without, but warmth and festivity within—in the friendly home of Gramp and Gram, to whom the book is dedicated.

Gramp with his homespun wisdom, racy humor, and knack for the pungent phrase shares with Gram the author's affections. Deep must have been their influence in shaping the character and tastes and in encouraging the aspirations of their youthful visitor. Evenings were often spent reading worthwhile books by lamplight. In the selection of nature books as in other ways Gram's high standard was the guide.

To earn money enough to buy a coveted camera the author had to pick a grand total of 20,000 strawberries. To acquire a typewriter demanded comparable persistence. Youthful compositions—intriguingly unorthodox in their spelling—were tapped out on this typewriter and some reappear in *Dune Boy* along with many delightfully told serio-comic rural adventures. They range from a small boy's endeavor to build up a fur trade in mouse skins to an ambitious attempt to soar in an airplane of his own construction. The author's early attempts at nature photography—of which today he is preeminently a master—are not represented, but attractive sketches by Edward Shenton top each of the thirty chapters.

Herbert F. Schwarz.

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GREETINGS 1943

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Because of the importance of the above message, this space has been contributed by

NATURAL HISTORY Magazine

Taxidermy

- - - - - - - - - - - by Leon Pray

The MacMillan Co., $1.49

Well I remember, many years ago, when in the Field (now the Chicago) Museum, as a boy with Carl Akeley, I met another young chap whom Akeley had just taken on. Akeley told me that he thought this boy had much promise, and I, too, was profoundly impressed by the almost photographic accuracy of his pencil sketches and very excellent oil paintings.

That boy, tutored by Akeley, grew up into a progressive and expert taxidermist, for not only did he have the necessary artistic background, but he had considerable mechanical skill as well.

With infinite study and continuous work, he carried on much research and experimented with methods both old and new, to find better ways, if possible, of producing lasting and quality work in this very fascinating, but somewhat elusive art.

Leon Pray's book, *Taxidermy*, is the result of these many years of experience, and although not a large volume, it covers well the phases of mounting he describes. His many excellent diagrammatic drawings of these methods and their details bespeak pages for the eager student and make this work just so much more comprehensive.

This art, too casually looked upon by the administrators of most natural history museums, is very largely kept alive and in a progressive state by men like Pray, who give their whole lifetime to study and methods in their effort to lift it to a higher plane of achievement and recognition.

This very good little book comes as a real contribution in a field wherein there is far too little literature. It will be received with enthusiasm by the amateur naturalist, the student, and the professional alike, for it contains many valuable hints for all.

James L. Clark.

OTHER REGIONAL BOOKLETS RECEIVED

Conspicuous Birds of the South Pacific—By Ken Stott Bulletin 19 of the Zoological Society of San Diego.

Fishes of the Middle West—By Rachel L. Carson. Conservation Bulletin 34 of the Fish and Wildlife Service.

Illinois Mammals Today and Yesterday—By Virginia Eifert. The Illinois State Museum.

South Sea Lore—By Kenneth P. Emory. Bernice P. Bishop Museum Special Publication 36, Honolulu.